ILLINOIS MINERAL INDUSTRY 1993–1996

and a Report on Water Resources of Illinois

Viju C. Ipe

Illinois Minerals 119 2000

Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY

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ABSTRACT

This report provides an overview of the mineral industry in Illinois, analyzing its status during the period from 1993 to 1996. Covered also are the major minerals extracted from the ground, minerals processed, and manufactured mineral products such as cement and lime (fig. 1). A section on water resources concludes the report. This report, the only one of its kind for Illinois, provides the basic information on the Illinois mineral industry needed to identify the problems and trends in this industry.

MINERAL INDUSTRY IN 1996

The total value of minerals extracted, processed, and manufactured in Illinois in 1996 was $2.12 billion, which is 4.3% lower than the reported values for 1995 and 25% less than the 1992 total value (table 1). Minerals extracted accounted for 90% of the reported value; processed crude minerals and manufactured minerals accounted for the remaining 10%. Among the extracted minerals, coal continued to lead in value, followed by industrial and construction materials and oil (fig. 2).

The minerals processed in the state included ground barite, expanded perlite, sulfur, calcined gypsum, exfoliated vermiculite, iron oxide pigments, slag and fly ash, natural gas liquids, bismuth, and primary and secondary slab zinc. Mineral products manufactured in Illinois, primarily those from minerals mined within the state, included cement (portland and masonry), coke, clay products, lime, and glass.

Illinois continues to be a significant contributor to the total U.S. production of minerals such as coal, sand and gravel, crushed stone, and industrial sand. In 1996, the state accounted for about 4.4% of the total production of coal in the country (table 2). The production of coal in 1996 was 3.2% lower than in 1995 and 22.1% lower than in 1992. However, coal production in 1994 was 28.5% higher than in 1993. In 1996, Illinois accounted for 5% of the nation's production of crushed stone and 3.7% of its sand and gravel. The state continues to lead the country in production of industrial sand. The production of construction sand in 1996 was 9.3% higher than in 1992. The production of stone in 1996 was 8.31% higher than in 1995 and 0.83% higher than in 1992.

Employment in mining, quarrying, and oil and gas extraction has been declining (table 3). The number of employees in the mining sector continued to decline, from 16,300 employees in 1993 to 12,600 in 1996, although total nonagricultural employment went up from 5.28 million in 1995 to 5.68 million in 1996.

Consumption of coal in Illinois accounted for about 4.5% of the total U.S. consumption (table 4). In 1995, the state's share of the consumption of petroleum ranged from 0.47% for residual fuel oil to 5.95% for lubricants. Data for consumption in 1996 were not available at the time this publication was compiled.

MINERALS EXTRACTED

Fuel Minerals

Coal

In terms of its dollar value, coal is the most important mineral produced in Illinois. The total value of the coal produced in Illinois in 1996 was $1,060.9 million (table 1), about 50% of the total value of all minerals produced. In spite of a downturn in production (table 5) in 1993, Illinois continued to be the fifth largest producer of coal in the nation. In 1996, Illinois accounted for 4.4% of the total production in the country.

Production Production remained near 60 million tons per year from 1966 to 1992 except in 1978, 1981, and 1983 (fig. 3), when production was affected by strikes. Production has been declining since 1992. The sharp decline (18 million tons) in production in 1993 was due to a workers' strike. Production never rebounded fully as it had after the previous strikes; rather, the strike signaled a

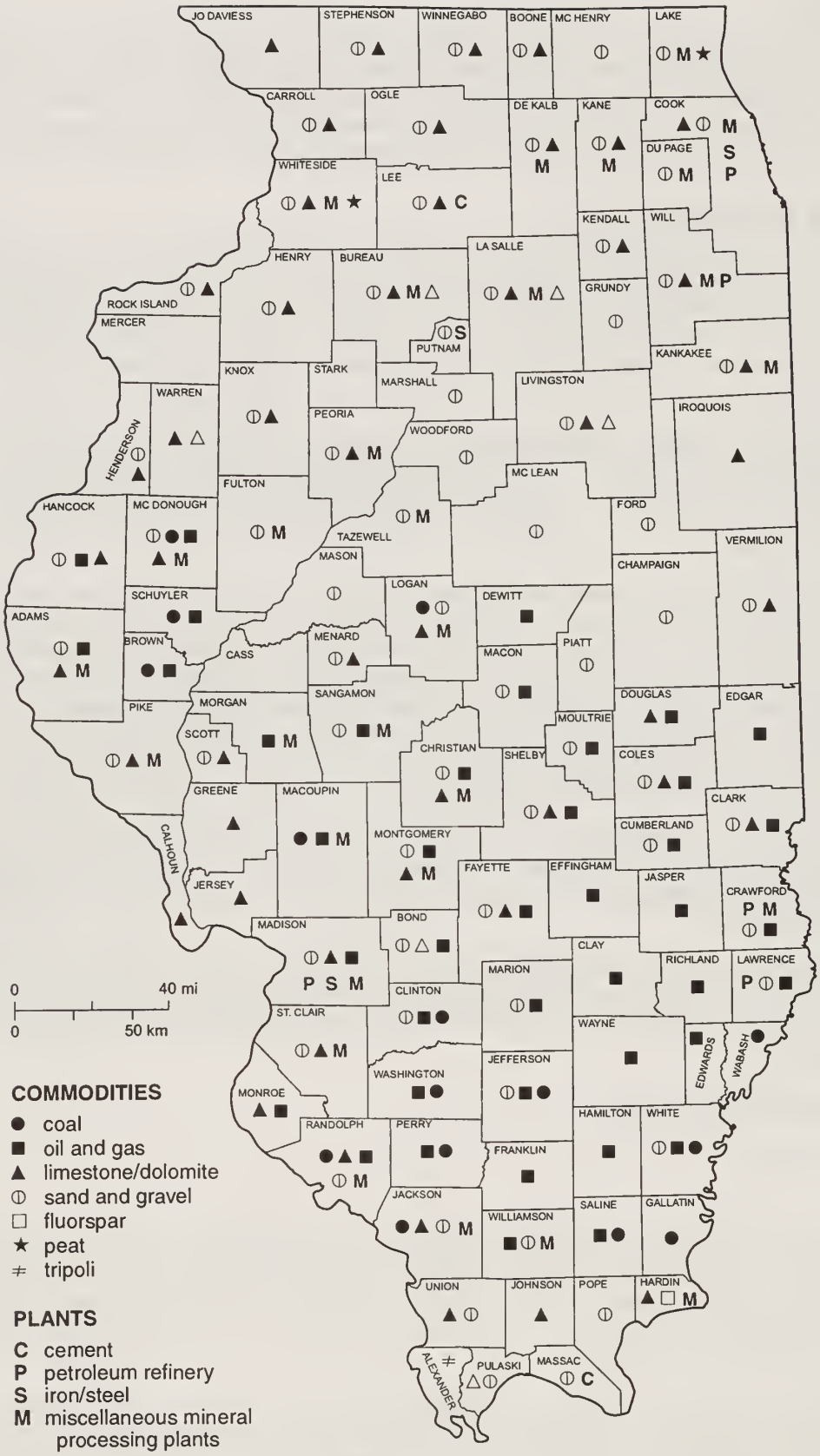

Figure 1 Mineral production and mineral processing plants

Table 1 Production and value of minerals extracted, processed, and manufactured into products in Illinois, 1992–1996

Minerals/unit	1992		1993		1994		1995		1996	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
FUELS										
Coal (thousand short tons)	59,857	1,655,645	41,098	1,038,546	52,797	1,221,723	48,180	1,110,549	46,656	1,060,957
Crude oil (thousand bbl)	19,137	368,586	17,726	306,000	17,148	278,000	16,190	267,135	15,575	277,235
Natural gas (million cu ft)	347	743	340	782	333	799	335	600	298	844
Subtotal (a)		2,024,974		1,345,328		1,500,522		1,378,284		1,339,036
NON-FUEL MINERALS										
Clay, common *(thousand m. tons)	535	2,362	477	1,090	494	1,170	504	1,220	792	627
Gemstones		715		328		376		269	NA	W
Sand and gravel										
Construction (thousand m. tons)	32,382	123,720	34,500	137,000	37,900	147,000	36,100	147,000	35,400	142,000
Industrial sand (thousand m. tons)	4,241	57,454	4,224	61,734	4,420	65,700	4,410	67,500	4,360	62,600
Stone (limestone and dolomite)										
Crushed, and broken (thousand m. tons)	65,952	322,800	61,484	315,149	62,600	353,000	61,400	335,000	66,600	364,000
Subtotal (b)		507,051		515,301		567,246		550,989		569,227
TOTAL value of minerals extracted (a)+(b)		2,532,025		1,860,629		2,067,768		1,929,273		1,908,263
PROCESSED										
Sulfur	267	12,285	297	8,340	303	5,200	308	5,310	NA	NA
Combined value of barite, cement, copper, flurospar, lead, lime, peat, silver,stone tripoli, and others		108,252		95,929		102,000		107,000		40,500
Sub-total (c)		120,537		104,269		107,200		112,310		40,500
MANUFACTURED INTO PRODUCTS										
Cement, portland (thousand m. tons)	2,595	118,982	2,430	123,000	2,590	151,000	2,560	169,000	2,540	168,000
Clay products		54,106					835	1,220		
Sub-total (d)		173,088		123,000		151,000		170,220		168,000
TOTAL VALUE (a)+(b)+(c)+(d)		2,825,650		2,087,898		2,325,968		2,211,803		2,116,763

Sources: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual, Natural Gas Annual, and Petroleum Supply Annual; U.S. Geological Survey, Mineral Industry Surveys

NA = not available
W = withheld to avoid disclosure of individual company data
Values are reported in 1,000 dollars
* Excluding absorbent clay
1 Metric ton = 1.1023 Short tons

sustained drop in production that is projected to continue for several more years (table 5, fig. 3).

The low price of low-sulfur western coal increased competition among electric utilities, and the Clean Air Act Amendments (CAAA) of 1990 are expected to continue to adversely affect coal production in Illinois. The CAAA of 1990 requires that electric utilities cut overall sulfur dioxide emissions by 50% by 2000. Compliance would require installation of costly scrubbers when high-sulfur Illinois coal is burned or the purchase of a free market device called "pollution credits" to permit continued higher emissions. The regulations and particularly the low price of western coal prompted many electric utilities to shift to western coal.

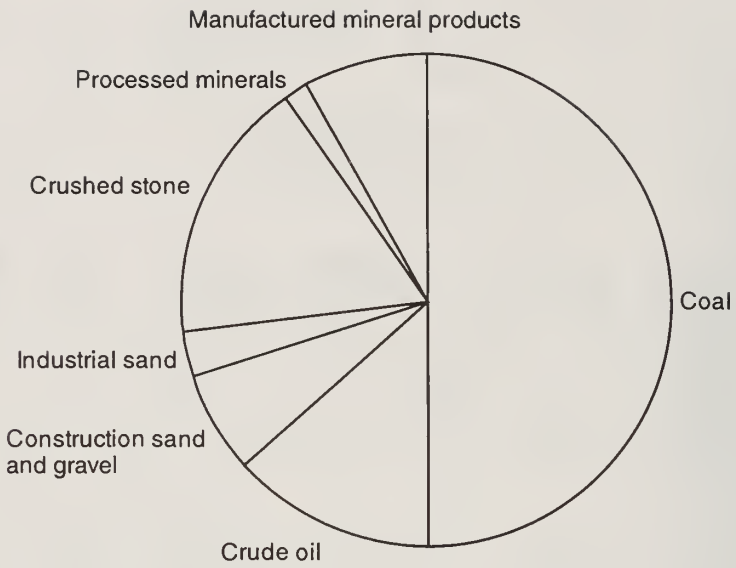

Figure 2 Relative value of minerals manufactered, processed, and extracted, 1996

The deregulation of electric utilities is another factor that may adversely affect the demand for Illinois coal by forcing utilities to reduce their average and marginal cost of electricity production, which may result in utilities using cheaper western coal, causing a further lowering of demand for Illinois coal.

Production from surface mines has been declining since 1980 as surface-minable deposits have been mined out and land reclamation costs have increased. Underground mines accounted for about 83% of the total coal produced in Illinois in 1996 compared with 56% in 1980. Similarly, the proportion of employment in underground mines went up from 72% in 1980 to 82.3% in 1996 (table 5, fig. 3).

Coal production by counties In 1996 17 counties produced coal (table 6, fig. 4) compared with 19 in 1993. Except for 1994, Saline County was the largest producer, contributing 20% of the total in 1996. Perry County was the second largest producer in 1996 (15.1%), followed by Franklin County (7.8%). In terms of cumulative production, however, Franklin County ranks first, followed by Perry County (table 7).

Coal production by companies During 1996, 18 companies produced coal (table 8, fig. 5) at 20 underground and 11 surface mines. Among the producing companies, Kerr-McGee Coal Corporation was the largest producer (14%). The other major producers were Old Ben Coal (12.3%) with four underground mines, Consolidation Coal Corporation (11.4%) with one underground and one surface mine, Arch of Illinois (10.6%), and Freeman United Coal (10%).

Productivity The productivity of underground coal mines in Illinois is higher than the national average (table 9, fig. 6) and generally has been increasing since 1979. The productivity of surface mines in Illinois is much less than the national average (table 9, fig. 7). The high average productivity of surface mines in the country is largely due to the relatively high productivity of surface mines in western states (Wyoming, Montana), which accounts for a major share of the total surface-mine production in the country. While the average productivity of surface mines in the country increased at an annual rate of 3.9% over the period 1960 to 1995, the growth in productivity of surface mines in Illinois was only 0.9%. But surface-mine productivity in Illinois compares favorably with that in the Indiana, Kentucky, and the Appalachian coal fields.

Table 2 Production and value of minerals in Illinois compared with U.S. mineral production, 1993–1996 (million dollars)

Commodity	Unit	Illinois		United States		Illinois % of U.S. production	
		Quantity	Value	Quantity	Value	Quantity	Value
1993							
Coal	million tons	41.09	975	945	18,767	4.3	5.2
Crude oil	million bbls	17.73	306	2,512	35,795	0.7	0.9
Natural gas	million cu ft	340.00	782	22,725,642	46,360	0.0	1.7
Clay	thousand tons	477.00	1	40,700	1,470	1.2	0.1
Sand and gravel							
Construction	million tons	34.50	137	869	3,530	4.0	3.9
Industrial	million tons	4.22	62	26	454	16.1	13.6
Stone (excluding dimension)	million tons	61.48	315	1,130	6,030	5.4	5.2
Cement, portland	million tons	2.43	123	72	3,920	3.4	3.1
1994							
Coal	million tons	54.03	1,365	1,034	20,060	5.2	6.8
Crude oil	million bbls	17.15	278	2,431	32,071	0.7	0.9
Natural gas	million cu ft	333.00	799	23,580,706	44,638	0.0	1.8
Clays	thousand tons	494.00	1	42,200	1,600	1.2	0.1
Sand and gravel							
Construction	million tons	37.90	151	891	3,740	4.3	4.0
Industrial	million tons	4.42	66	27	488	16.2	13.5
Stone (excluding dimension)	million tons	62.60	353	1,230	6,620	5.1	5.3
Cement, portland	million tons	2.59	151	74	4,460	3.5	3.4
1995							
Coal	million tons	48.18	1,142	1,033	19,244	4.7	5.9
Crude oil	million bbls	16.19	267	2,383	34,845	0.7	0.8
Natural gas	million cu ft	335.00	600	23,743,628	44946.43	0.0	1.3
Clays	thousand tons	504.00	1	40,700	1,480	1.2	0.1
Sand and gravel							
Construction	million tons	36.10	139	910	3,910	4.0	3.6
Industrial	million tons	4.41	66	28	502	15.6	13.1
Stone (excluding dimension)	million tons	61.40	335	1,260	6,750	4.9	5.0
Cement, portland	million tons	2.56	169	73	4,920	3.5	3.4
1996							
Coal	million tons	46.66	1,061	1,064	19,681	4.4	5.4
Crude oil	million bbls	15.58	277	2,366	43,677	0.7	0.6
Natural gas	million cu ft	298.00	864	24,051,665	52,192	0.0	1.7
Clays	thousand tons	792.00	1	43,100	1,577	1.8	0.0
Sand and gravel							
Construction	million tons	35.40	142	914	4,003	3.9	3.5
Industrial	million tons	4.36	63	28	495	15.7	12.7
Stone (excluding dimension)	million tons	66.60	36	1,330	7,182	5.0	0.5
Cement, portland	million tons	2.54	168	79	5,905	3.2	2.8

Sources: Energy Information Administration, Coal Industry Annual (1993,1995); United States Geological Survey, Mineral Industry Survey (1993, 1995); and Illinois State Geological Survey (unpublished data)

Table 3 Employment and wages in the Illinois mineral industry, 1993–1996

	1993				1994				1995				1996			
	No. of employees (1000)	Av. wkly earnings	Hrs/wk	Av. hrly earnings	No. of employees (1000)	Av. wkly earnings	Hrs/wk	Av. hrly earnings	No. of employees (1000)	Av. wkly earnings	Hrs/wk	Av. hrly earnings	No. of employees (1000)	Av. wkly earnings	Hrs/wk	Av. hrly earnings
Mining	16.3	$682.34	40.14	$16.99	15.5	$685.26	40.5	$16.92	13.7	$693.46	41.8	$16.59	12.6	$706.44	42	$16.82
Masonry, stonework	15.7	$701.61	35.15	$19.9	15.7	$698.95	35	$19.97	16.4	$745.96	36.3	$20.55	16.7	$791.48	37.6	$21.05
Stone, clay, glass	20.2	$493.21	40.42	$12.17	20.6	$500.6	40.6	$12.33	21	$538.26	41.5	$12.97	21.3	$564.48	42	$13.44
Primary metal industries	49.24	$591.34	42.83	$13.81	49.4	$599.62	43.2	$13.88	46.1	$615.47	43.1	$14.28	45.8	$634.1	42.7	$14.85
Blast furnaces	20.76	$624.02	43.2	$14.52	20.6	$639.92	43.8	$14.61	20.6	$665.11	43.7	$15.22	20.5	$697.31	43.5	$16.03
Iron and steel foundries	6.4	$620.51	41.1	$15.12	6.4	$618.14	41.1	$15.04	6.6	$669.88	44.1	$15.19	6.4	$650.16	43	$15.12
Petroleum and coal products	10.04	$695.49	41.8	$16.69	10	$706.43	41.9	$16.86	9.8	$717.38	41.3	$17.37	10.1	$752.24	41.4	$18.17
Gas production and distribution	7.94	$697.44	46	$15.19	7.8	$704.69	45.7	$15.42	7.6	$754.33	45.8	$16.47	7.4	$751.96	44.6	$16.86
Total nonagricultural	5283.7				5330.5				5593.1				5676			
Goods producing	1144.3				1149.1				1192.5				1205.3			
Service producing	4143.4				4181.4				4400.6				4470.7			

Source: Bureau of Labor Statistics, U.S. Department of Labor, Monthly Report on Employment, Hours, and Earnings
Employment figures are rounded to the nearest hundred.

Table 4 Consumption of fuel and non-fuel minerals in Illinois compared with U.S. consumption, 1992–1995

		1992			1993			1994			1995		
Mineral	Unit	Illinois	U.S.	Illinois share (%)	Illinois	U.S.	Illinois share (%)	Illinois	U.S.	Illinois share (%)	Illinois	U.S.	Illinois share (%)
FUELS													
Coal	million tons	31.60	892	3.54	38.14	926	4.12	39.08	930	4.20	44.47	984	4.52
Petroleum													
Asphalt and road oil	million bbl	9.29	166	5.60	6.31	173	3.65	7.80	177	4.41	7.46	178	4.19
Aviation gasoline	million bbl	0.18	8	2.20	0.23	8	2.89	0.20	8	2.55	0.22	8	2.69
Distillate fuel oils	million bbl	36.38	1,090	3.34	38.38	1,110	3.46	33.95	1,154	2.94	37.53	1170	3.21
Jet fuel	million bbl	7.40	532	1.39	9.17	536	1.71	9.62	557	1.73	10.36	553	1.87
Kerosene	million bbl	0.14	15	0.95	0.18	18	0.98	0.20	18	1.12	0.29	20	1.46
LPG and ethane	million bbl	12.48	642	1.94	12.08	633	1.91	24.71	686	3.60	25.82	693	3.73
Lubricants	million bbl	3.24	54	6.01	3.30	55	6.00	3.45	58	5.95	3.39	57	5.95
Motor gasoline	million bbl	106.32	2,660	4.00	109.55	2,729	4.01	111.29	2,774	4.01	111.21	2843	3.91
Residual fuel oil	million bbl	2.35	401	0.59	2.28	394	0.58	2.71	373	0.73	1.46	311	0.47
Other	million bbl	32.66	665	4.91	31.43	635	4.95	36.70	662	5.54	34.91	637	5.48
TOTAL	million bbl	210.45	6,234	3.38	212.92	6,291	3.38	230.64	6,467	3.57	232.65	6460	3.60
Natural gas	trillion cu ft	99.30	1,954	5.08	1.03	20	5.08	1.02	21	4.95	1.08	22	5.00
NON-FUEL													
Crushed stone	million tons	60.5	1053	5.74	61.5	1120	5.49	62.6	1230	5.09	61.4	1260	4.87
Limestone	million tons	NA	NA	NA	45.3	794	5.71	47.6	788	6.04	48	804	5.97
Dolomite	million tons	NA	NA	NA	W	90	W	W	93	W	13.4	93.1	14.39
Sand and gravel, construction	million tons	28.1	834	3.37	34.5	869	3.97	37.9	891	4.25	36.1	907	3.98
Cement, portland	million tons	3.6	89.7	4.01	3.30	71	4.64	3.59	75	4.78	3.30	85	3.90

Sources: Energy Information Administration, U.S. Department of Energy, State Energy Data Reports (1993, 1994, 1995; consumption estimates); U.S. Geological Survey, Mineral Industry Surveys (1994, 1995, 1996; annual estimates)

W = witheld NA = not available

Table 5 Production, number of mines, and employment in the coal sector in Illinois, 1960–1996

Year	All mines			Surface mines			Underground mines		
	No. of mines	Employment	Production (million tons)	No. of mines	Employment	Production (million tons)	No. of mines	Employment	Production (million tons)
1960	78	9,772	43.70	40	3,168	20.95	38	6,604	22.76
1961	67	8,252	42.83	36	3,114	21.00	31	5,138	21.83
1962	62	7,892	45.26	37	2,984	22.48	27	4,908	22.78
1963	67	8,002	48.38	42	3,089	25.19	25	4,913	23.18
1964	68	8,225	51.89	40	3,091	27.86	28	5,134	24.02
1965	63	8,135	55.45	39	3,053	30.71	24	5,082	24.74
1966	56	8,298	59.26	35	3,143	33.73	21	5,155	25.54
1967	52	8,054	60.49	32	3,129	34.79	20	4,925	25.69
1968	48	8,547	57.67	25	3,173	34.14	23	5,374	23.53
1969	62	9,591	64.83	34	3,647	34.66	48	5,944	30.17
1970	59	9,272	65.12	31	3,220	33.03	28	6,057	32.09
1971	63	10,571	58.42	36	3,483	28.96	27	7,088	29.45
1972	59	11,237	65.52	33	3,367	33.81	26	7,870	31.72
1973	56	11,409	61.55	32	3,615	28.97	24	7,794	32.58
1974	55	12,467	58.07	32	3,749	26.97	23	8,718	31.10
1975	58	12,850	59.54	37	3,840	27.66	21	9,010	31.88
1976	62	14,731	58.14	39	4,335	27.22	23	10,396	30.91
1977	70	16,114	53.88	45	4,739	24.29	25	11,375	29.59
1978	71	17,861	48.74	43	5,241	23.85	28	12,620	24.89
1979	71	18,499	59.54	40	5,299	26.86	31	13,200	32.68
1980	66	17,735	62.54	35	5,125	27.57	31	12,610	34.97
1981	58	18,418	51.80	27	4,797	22.56	31	13,351	29.24
1982	61	14,950	61.43	28	4,396	25.74	33	10,554	35.68
1983	55	15,825	56.85	23	4,315	25.01	32	11,510	31.84
1984	55	13,339	63.77	22	3,545	25.27	33	9,794	38.50
1985	54	13,858	59.20	20	3,509	21.86	34	10,349	37.34
1986	53	13,003	61.87	21	3,450	22.15	32	9,553	39.72
1987	51	12,171	59.16	22	3,239	21.63	29	8,932	37.52
1988	48	10,022	58.59	20	2,582	20.07	28	7,440	38.52
1989	48	10,003	59.27	18	1,919	19.93	30	8,084	39.34
1990	45	10,018	60.39	17	2,611	18.72	28	7,407	41.67
1991	51	9,102	60.26	15	2,046	17.12	29	7,056	43.13
1992	43	8,323	59.86	12	1,543	12.89	27	6,780	46.96
1993	39	7,303	41.10	12	1,107	8.00	25	6,196	33.10
1994	34	6,591	52.80	11	996	9.52	23	5,595	43.28
1995	31	5,652	48.18	11	872	7.06	20	4,780	41.12
1996	31	5,174	46.66	11	918	7.71	20	4,256	38.95

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (various volumes)

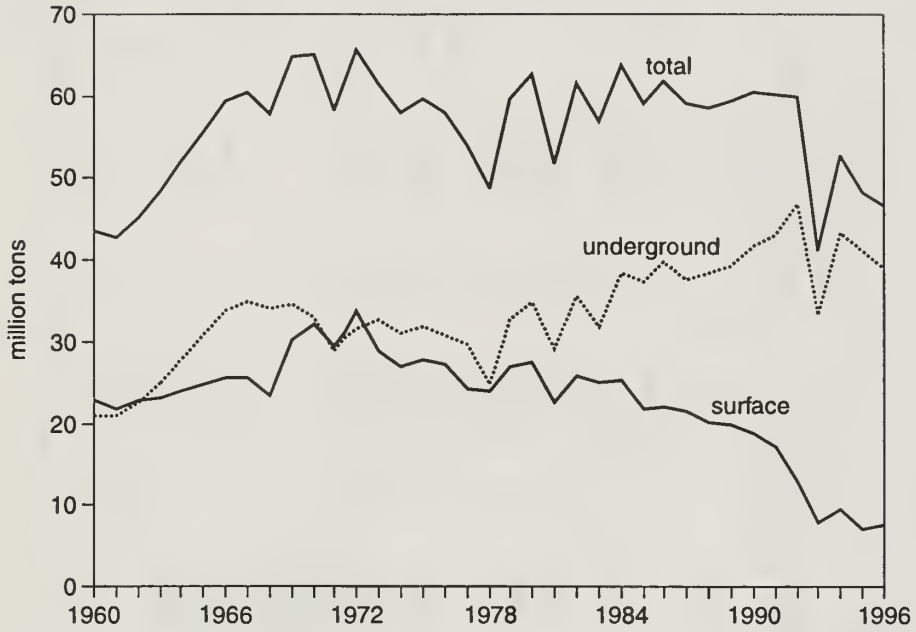

Figure 3 Trends in coal production in Illinois, 1960–1996

Employment Employment in the coal mining sector in Illinois increased from 9,772 persons in 1960 to an all-time high of 18,499 in 1979 but has generally been falling thereafter, reaching 5,174 persons in 1996 (table 5, fig. 8). Underground mines account for 82% of the total employment in 1996.

Coal demand Total demand for coal (Illinois mined and non-Illinois coal) in Illinois has been increasing recently (table 10, fig. 9). During the period from 1989 to 1996, the demand by all consumers increased at an annual rate of 4.9%. In 1996, electric utilities accounted for about 88% of the total demand for coal in Illinois. Industrial consumers, including coke plants, accounted for the rest of the demand for coal. Although coal consumption by electric utilities is increasing, Illinois coal's share of the total amount consumed in the state is declining (table 11).

Prices Average mine prices, prices paid by electric utilities, and prices paid by industrial consumers have generally decreased in Illinois (table 10) and at the national level (table 12). Over the period from 1989 to 1996, the average mine prices, prices paid by electric utilities, and prices paid by industrial consumers fell at an average annual rate of 2.9%, 2.6%, and 0.7%, respectively.

Distribution of coal produced in Illinois In 1996, of the total Illinois-mined coal distributed domestically, only 35.5% was used for consumption within Illinois. About 1.89 million tons (4% of the total) was exported to foreign countries.

Coal produced in Illinois is distributed to six major geographical regions: East North Central, West North Central, South Atlantic, East South Central, West South Central, and the Mountain regions (table 13). The East North Central region, consisting of Illinois, Indiana, Michigan, Ohio, and Wisconsin (table 13), received the major share of the coal mined in Illinois, 53% in 1996. The major destinations for Illinois coal for use in electricity generation are Illinois, Indiana, Florida, Missouri, and Tennessee (table 14, fig. 10). Consumption of Illinois coal by electric utilities in Illinois, Missouri, and Georgia has in general been decreasing over the last few years (table 14).

Table 6 Coal production in Illinois counties, 1993–1996 (thousand tons)

	1993				1994				1995				1996			
County	No.of mines	Underground	Surface	Total	No. of mines	Underground	Surface	Total	No. of mines	Underground	Surface	Total	No. of mines	Underground	Surface	Total
Christian	1	1,545		1,545	1	1,457		1,457								
Clinton	1	1,065		1,065	1	3,007		3,007	1	2998		2,998	1	1,701		1,701
Franklin	3	4,078		4,078	3	6,602		6,602	2	5298		5,298	2	3,635		3,635
Fulton	1		429	429	1		499	499	1		469	469	1		205	205
Gallatin	3	1,963	275	2,238	2	1,093	316	1,409	1	1086		1,086	1	1,324		1,324
Jackson	1		25	25					1		19	19				
Jefferson	2	2,682		2,682	2	4,138		4,138	2	4705		4,705	2	4,299		4,299
Logan	1	1,498		1,498	1	1,673		1,673	1	1745		1,745	1	1,982		1,982
Macoupin	3	4,383		4,383	3	4,809		4,809	3	4815		4,815	3	5,454		5,454
McDonough	1		431	431	1		434	434	1		278	278	1		533	533
Perry	6	1,731	4,512	6,242	8	3,283	6,276	9,559	6	2494	4153	6,647	4	1,850	5,213	7,064
Randolph	3	2,102		2,102	2	3,434		3,434	2	2891		2,891	2	2,103		2,103
Saline	6	7,088	1,720	8,809	4	6,682	1,388	8,070	4	7463	346	7,809	4	8,660	673	9,333
Schuyler	1		584	584	1		603	603	1		504	504	1		415	415
St. Clair	1	242		242	1	227		227								
Vermilion													1	130		130
Wabash	1	2,129		2,129	1	2,676		2,676	1	2557		2,557	1	2,340		2,340
Washington	1	592		592	1	2,225		2,225	1	3259		3,259	1	3,674		3,674
White	1	1,996		1,996	1	1,977		1,977	1	1808		1,808	1	1,796		1,796
Williamson	2		27	27					2		1293	1,293	4		668	668
TOTAL	39	33,096	8,002	41,098	34	43,281	9,516	52,797	31	41,118	7,062	48,180	31	38,948	7,707	46,656

Sources: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (1993–1996); Illinois Department of Natural Resources (unpublished data)

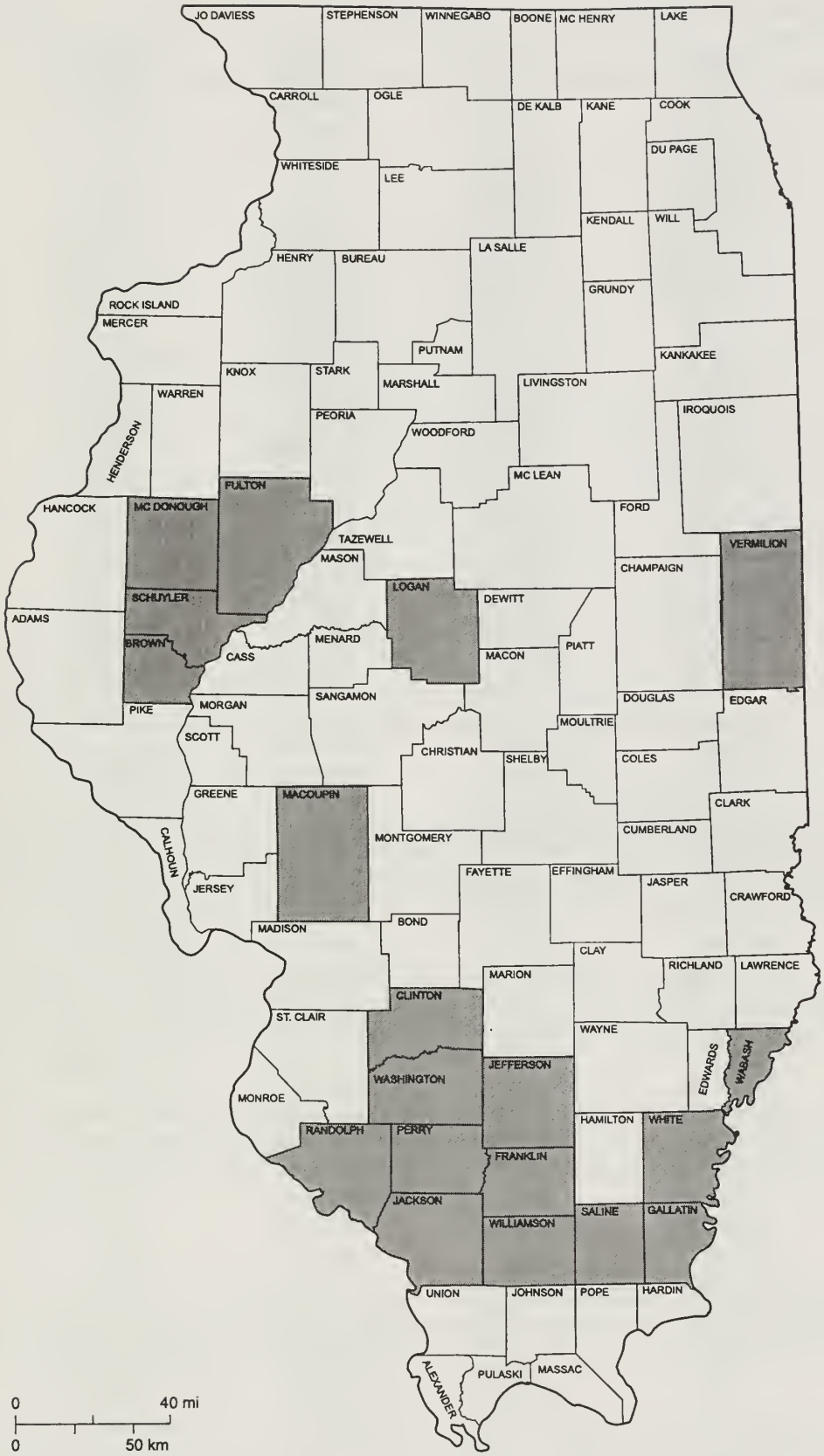

Figure 4 Counties producing coal in 1996

Table 7 Cumulative coal production in Illinois counties, 1992–1996 (thousand short tons)

County	To 1992	To 1993	To 1994	To 1995	To 1996
Adams	341.92	341.92	341.92	341.92	341.92
Bond	7,355.57	7,355.57	7,355.57	7,355.57	7,355.57
Brown	74.07	74.07	74.07	74.07	74.07
Bureau	53,823.06	53,823.06	53,823.06	53,823.06	53,823.06
Calhoun	96.25	96.25	96.25	96.25	96.25
Cass	212.48	212.48	212.48	212.48	212.48
Christian	355,957.93	357,502.93	358,959.72	358,959.72	358,959.72
Clark	4.48	4.48	4.48	4.48	4.48
Clay	0.80	0.80	0.80	0.80	0.80
Clinton	76,562.19	77,627.19	80,633.94	83,631.94	85,332.94
Coles	210.93	210.93	210.93	210.93	210.93
Crawford	45.40	45.40	45.40	45.40	45.40
Douglas	44,397.20	44,397.20	44,397.20	44,397.20	44,397.20
Edgar	2,295.90	2,295.90	2,295.90	2,295.90	2,295.90
Effingham	0.80	0.80	0.80	0.80	0.80
Franklin	701,374.66	705,452.66	712,054.41	717,352.41	720,987.41
Fulton	317,006.92	317,435.92	317,934.59	318,403.59	318,608.59
Gallatin	53,355.55	55,593.55	57,002.30	58,088.30	59,412.30
Greene	693.19	693.19	693.19	693.19	693.19
Grundy	40,872.43	40,872.43	40,872.43	40,872.43	40,872.43
Hamilton	6,172.93	6,172.93	6,172.93	6,172.93	6,172.93
Hancock	771.28	771.28	771.28	771.28	771.28
Hardin	0.04	0.04	0.04	0.04	0.04
Henry	22,910.05	22,910.05	22,910.05	22,910.05	22,910.05
Jackson	128,204.82	128,229.82	128,239.06	128,258.06	128,258.06
Jasper	23.74	23.74	23.74	23.74	23.74
Jefferson	166,256.68	168,938.68	173,076.36	177,781.36	182,080.36
Jersey	120.35	120.35	120.35	120.35	120.35
Johnson	314.32	314.32	314.32	314.32	314.32
Kankakee	19,192.10	19,192.10	19,192.10	19,192.10	19,192.10
Knox	65,896.60	65,896.60	65,896.60	65,896.60	65,896.60
La Salle	65,547.64	65,547.64	65,547.64	65,547.64	65,547.64
Livingston	10,111.44	10,111.44	10,111.44	10,111.44	10,111.44
Logan	25,088.38	26,586.38	28,260.11	30,005.11	31,987.11
Macon	11,000.47	11,000.47	11,000.47	11,000.47	11,000.47
Macoupin	337,161.70	341,544.70	346,533.75	351,348.75	356,802.75
McDonough	164,295.77	164,726.77	165,160.66	165,438.66	165,971.66
McLean	39,247.72	39,247.72	39,247.72	39,247.72	39,247.72
Madison	12,516.14	12,516.14	12,516.14	12,516.14	12,516.14
Marion	7,569.55	7,569.55	7,569.55	7,569.55	7,569.55
Marshal	5,544.14	5,544.14	5,544.14	5,544.14	5,544.14
Menard	13,462.00	13,462.00	13,462.00	13,462.00	13,462.00
Mercer	15,519.86	15,519.86	15,519.86	15,519.86	15,519.86
Monroe	8.28	8.28	8.28	8.28	8.28
Montogomery	141,824.66	141,824.66	141,824.66	141,824.66	141,824.66
Morgan	190.79	190.79	190.79	190.79	190.79
Moultrie	2,032.24	2,032.24	2,032.24	2,032.24	2,032.24
Peoria	96,718.74	96,718.74	96,718.74	96,718.74	96,718.74
Perry	491,175.25	497,417.25	506,694.35	513,341.35	520,405.35
Pike	5.08	5.08	5.08	5.08	5.08
Pope	36.27	36.27	36.27	36.27	36.27

Table 7 (continued)

County	To 1992	To 1993	To 1994	To 1995	To 1996
Putnam	10,071.89	10,071.89	10,071.89	10,071.89	10,071.89
Randolph	237,318.16	239,420.16	242,854.16	245,745.16	247,848.16
Richland	0.15	0.15	0.15	0.15	0.15
Rock Island	3,846.17	3,846.17	3,846.17	3,846.17	3,846.17
St. Clair	367,370.81	367,612.81	367,612.81	367,612.81	367,612.81
Saline	319,815.71	328,624.71	335,306.65	343,115.65	352,448.65
Sangamon	233,449.61	233,449.61	233,449.61	233,449.61	233,449.61
Schuyler	12,752.07	13,336.07	13,942.04	14,446.04	14,861.04
Scott	612.48	612.48	612.48	612.48	612.48
Shelby	4,119.76	4,119.76	4,119.76	4,119.76	4,119.76
Stark	9,569.34	9,569.34	9,569.34	9,569.34	9,569.34
Tazwell	17,633.80	17,633.80	17,633.80	17,633.80	17,633.80
Vermilion	165,878.43	165,878.43	165,878.43	165,878.43	166,008.43
Wabash	44,394.11	44,394.11	48,387.95	50,944.95	53,284.95
Warren	685.47	685.47	685.47	685.47	685.47
Washington	37,271.32	37,863.32	40,315.57	43,574.57	47,248.57
White	14,075.33	16,071.33	18,068.72	19,876.72	21,672.72
Will	37,553.73	37,553.73	37,553.73	37,553.73	37,553.73
Williamson	463,856.06	463,883.06	465,270.65	466,563.65	467,231.65
Woodford	7,810.16	7,810.16	7,810.16	7,810.16	7,810.16
TOTAL	5,491,685.33	5,530,653.18	5,584,699.54	5,632,880.54	5,679,536.54

Source: Office of Mines and Minerals, Department of Natural Resources, Annual Statistical Report

Consumption of coal in Illinois Electric utilities are the major consumers of coal in Illinois. In 1995, electric utilities accounted for 83% of the total consumption. The share of Illinois coal in the total coal used in the state is declining. It fell from about 80% in 1970 to about 36% in 1996. While the share of Illinois coal has been falling, the share of Wyoming coal has been increasing significantly since 1991 (table 15).

Cost and quality of Illinois coal The quality of coal used for electricity generation and other industrial purposes is judged in terms of its sulfur, ash, and energy contents. Both the price per unit quantity and price per million Btu of Illinois coal are higher than the respective prices for Wyoming coal (table 16).

Although Illinois coal has a higher heat content, it is inferior because of the higher sulfur and ash contents. This difference is a significant disadvantage for Illinois coal relative to western coals in the context of the environmental regulations facing the utility industry, and is exacerbated by its higher average price.

Crude Oil

Production During 1996, crude oil accounted for 13% of the total value of minerals produced in the state. Production fell by 3.8% from 16.2 million barrels in 1995 to 15.6 million barrels in 1996 (table 1), and has been decreasing since 1985 (fig. 11). The unit value of crude oil in 1996 was $17.8 per barrel, which represents a 7.8% increase from 1995.

Crude oil production reached a peak of 147.6 million barrels in 1940. Since then, oil produced by primary recovery methods declined rather steadily until 1975, although some years showed small gains. Introduction of the hydraulic rock-fracturing method in 1954 and the increased use of water flooding for secondary recovery stabilized oil production at about 78 million barrels per year from

Table 8 Production of coal by company, 1993–1996 (in thousand tons)

Company	1993				1994				1995				1996			
	No. of mines				No. of mines				No. of mines				No. of mines			
	Under-ground	Surface	Production	% of total	Under-ground	Surface	Production	% of total	Under-ground	Surface	Production	% of total	Under-ground	Surface	Production	% of total
Amax Coal	1	1	4,927	11.99	1	1	5,381	10.19	1	1	5,348	11.10	1	1	3761	8.06
Arch of Illinois	2	2	4,425	10.77	2	2	6,055	11.47	2	1	4,286	8.90	1	1	4933	10.57
Arclar Co.	1		1,264	3.07	1		1,342	2.54	1		1,446	3.00	1		1452	3.11
Brushy Creek Coal	1		1,334	3.25	1		1,323	2.51	1		506	1.05	1		577	1.24
Catlin Coal Company													1		123	0.26
Central Mining Co.						1	9	0.02								
Coal Miners Inc.	1		1,199	2.92	1		1,093	2.07	1		1,086	2.25	1		1322	2.83
Consolidation Coal	1	2	3,222	7.84	1	2	5,928	11.23	1	2	5,511	11.44	1	1	5314	11.39
Cottonwood Coal Co.													1		36	0.08
Freeman United	3	1	4,388	10.68	3		4,279	8.10	3	1	4,429	9.19	3	1	4668	10.00
Jader Fuel Co.		1	264	0.64		1	316	0.60		1	346	0.72		1	673	1.44
Kerr-McGee Coal Corp.	1		4,162	10.13	1		4,017	7.61	1		5,510	11.44	1		6520	13.98
Midstate Coal	1		429	1.04	1		499	0.94	1		469	0.97	1		205	0.44
Monterey Coal	2		2,769	6.74	2		5,148	9.75	2		5,099	10.58	2		4133	8.86
Old Ben Coal	6		5,359	13.04	5		10,036	19.01	4		8,189	17.00	4		5725	12.27
Peabody Coal	4		3,771	9.17	2		3,909	7.40	1		3,259	6.76	1		3674	7.87
Phoenix Mining Co.		1	20	0.05												
Triad Mining Inc.		1	587	1.43		1	606	1.15		1	500	1.04		1	417	0.89
Turris Coal Co.	1		1,501	3.65	1		1,674	3.17	1		1,745	3.62	1		1982	4.25
White County Coal	1		1,996	4.86	1		1,977	3.75	1		1,808	3.75	1		1796	3.85
TOTAL	27	10	41,098	100	23	8	52,797	100	21	7	48,180	100	21	6	46,656	100

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual

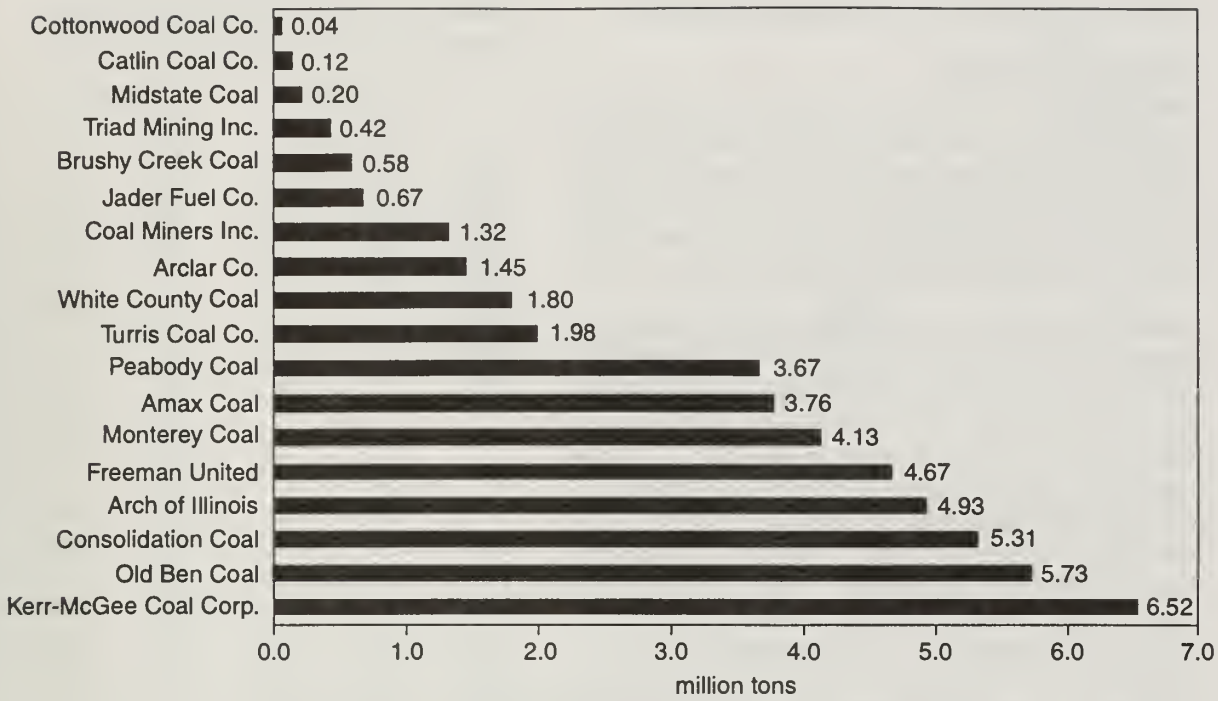

Figure 5 Coal production by producing companies, 1996

1955 to 1962. Production has declined since 1962 and has fallen to 15.6 million barrels in 1996, the lowest since long before1940. The reasons for the declining trends in oil production are the low oil prices, relatively high average costs of production, and depletion of reserves.

An oil field producing more than 200,000 barrels per year is considered a major oil field in Illinois. In 1996, there were 11 major oil fields, which together produced 52% of the state's total production that year (table 17). The three largest oil fields, Lawrence, Clay City Consolidated, and Main Consolidated, each produced one million barrels or more during 1996, or 26% of the state's total.

Consumption The major petroleum products consumed in Illinois are motor gasoline, distillate fuel oil, liquefied petroleum gas, and jet fuel (table 18, fig. 12). Motor gasoline has been the major petroleum product consumed. In 1995, it accounted for 51.5% of the total quantity of petroleum products consumed, followed by distillate fuel (18%) and liquefied petroleum gases (5.7%).

Natural Gas

Production Illinois is not a major producer of natural gas and is almost totally dependent on gas produced elsewhere. Production of natural gas fell from 340 million cubic feet in 1993 to 291 million cubic feet in 1996 (table 19). The average wellhead value of gas decreased from $2.4 per thousand cubic feet in 1994 to $1.8 in 1995.

Saline County was the top producer of natural gas in 1996, followed by St. Clair County (table 20, fig. 13). As more and more gas and oil fields are being idled or depleted in Illinois, gas production in Illinois is expected to continue to fall in the future.

Consumption Natural gas consumption in the state began to decline after 1971 and reached its lowest level in 1987. The consumption in the state has generally been increasing in the 1990s (table 21, fig. 14). In 1996, residential consumers accounted for about 48% of total natural gas consumption in Illinois, followed by industrial consumers (28.8%). The other major consumers are commercial users (19.4%) and electric utilities (2.3%).

Industrial and Construction Materials

Sand and Gravel

Production In 1996, 68 counties produced sand and gravel (fig. 15). The primary sources of construction sand and gravel are glacial deposits, primarily valley trains and outwash plains. Because of environmental regulations and zoning restrictions, new operations tend to be located away from highly populated areas.

Illinois continues to be a leading producer of sand and gravel in the country, ranking seventh among the producing states. In 1996, the state produced 35.4 million tons of construction sand (3.9% of the nation's production) valued at $142 million. Since sand and gravel are bulk commodities that have high transportation costs, these operations generally are located as close as possible to the major areas of demand, but away from densely populated areas. Production of sand and gravel has generally increased since the mid-1980s (fig. 16), except in 1991. The relatively low rate of highway construction in some areas of the state and the efforts of the state highway department to improve the performance of bituminous and portland cement pavements might have affected production of sand and gravel in 1991. Gravel producers have experienced difficulties in meeting the upgraded state quality specifications in 1991, which in turn affected total production.

Nine counties (Cook, Du Page, Grundy, Kane, Lake, McHenry, Peoria, Tazewell, and Woodford), each producing more than one million tons, accounted for 70% of the sand and gravel production in Illinois. The state is divided into four sand-and-gravel-producing districts. District 1, which includes Cook County and surrounding areas, is the major producer of construction sand and gravel. District 1 produced 66% of the total production; District 2, 9%; District 3, 17%; and District 4, 8%.

Consumption Sand and gravel are used primarily for various types of construction aggregates for buildings and roads. The major markets for sand and gravel are in Cook County and the five surrounding metropolitan counties, where over 60% of Illinoisans live. Because of its low unit price, most construction sand and gravel is not shipped farther than 50 miles from the pit, although operations on navigable rivers may ship material much farther by barge. About three-quarters of the material is shipped from the pit by truck, and the remainder by barge or rail.

Table 9 Productivity of coal mining in Illinois and the U.S.,1960–1996 (tons/person/day)

	Underground		Surface	
Year	U.S.	Illinois	U.S.	Illinois
1960	10.6	17.4	22.9	30.0
1961	11.4	19.4	25.0	30.5
1962	12.0	20.4	26.8	30.9
1963	12.8	20.8	28.7	33.7
1964	13.7	21.1	29.3	35.5
1965	14.0	21.0	32.0	37.5
1966	14.6	21.9	33.6	41.0
1967	15.1	22.4	35.2	41.6
1968	15.4	22.2	34.2	39.4
1969	15.6	22.9	35.7	37.6
1970	13.8	21.0	36.0	33.5
1971	12.0	18.8	35.7	34.9
1972	11.9	17.9	36.3	37.1
1973	11.7	18.1	36.7	35.8
1974	11.3	15.8	33.2	26.5
1975	9.5	14.2	26.7	24.2
1976	9.1	13.4	26.4	22.8
1977	8.7	12.8	26.6	19.2
1978	8.4	10.7	25.8	20.2
1979	9.2	11.9	26.5	20.1
1980	9.8	12.3	27.6	22.1
1981	10.6	11.8	30.2	20.0
1982	11.1	13.4	29.3	20.0
1983	13.0	14.4	31.0	23.5
1984	13.8	15.3	32.8	23.7
1985	14.2	15.3	34.0	21.5
1986	16.4	17.0	39.9	26.0
1987	18.2	18.5	43.5	27.2
1988	19.8	20.3	46.8	26.7
1989	20.4	20.4	49.6	31.6
1990	21.2	22.6	52.5	29.3
1991	22.5	24.0	56.7	34.3
1992	24.6	26.9	58.6	36.3
1993	23.6	24.9	57.8	30.9
1994	25.5	27.9	61.4	33.0
1995	27.1	30.9	76.6	37.4
1996	28.6	32.8	72.4	37.4

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (various volumes)

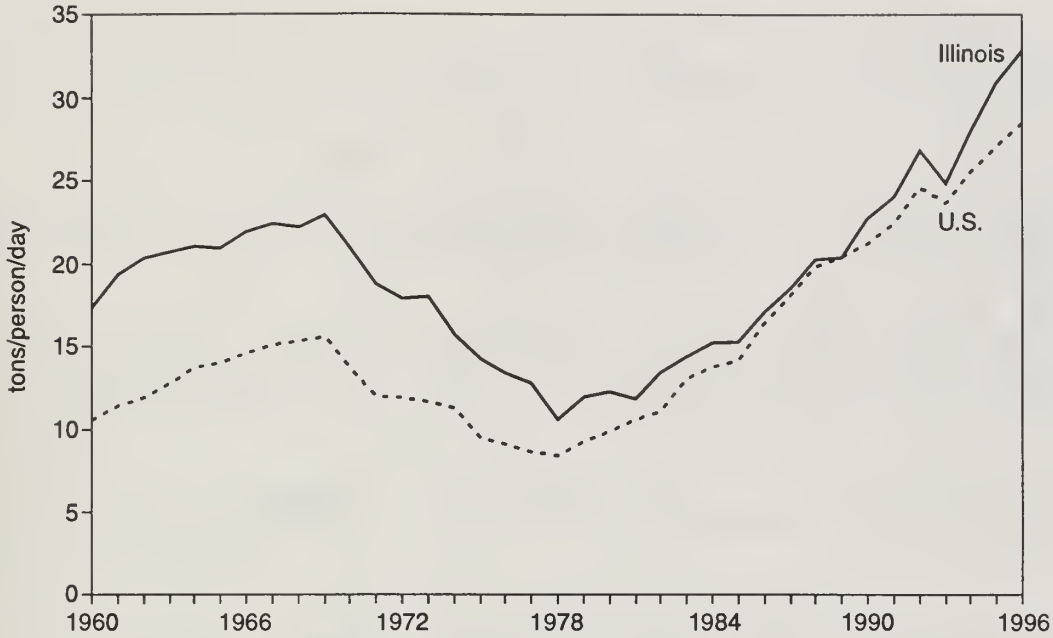

Figure 6 Trends in productivity of underground mines, 1960–1996

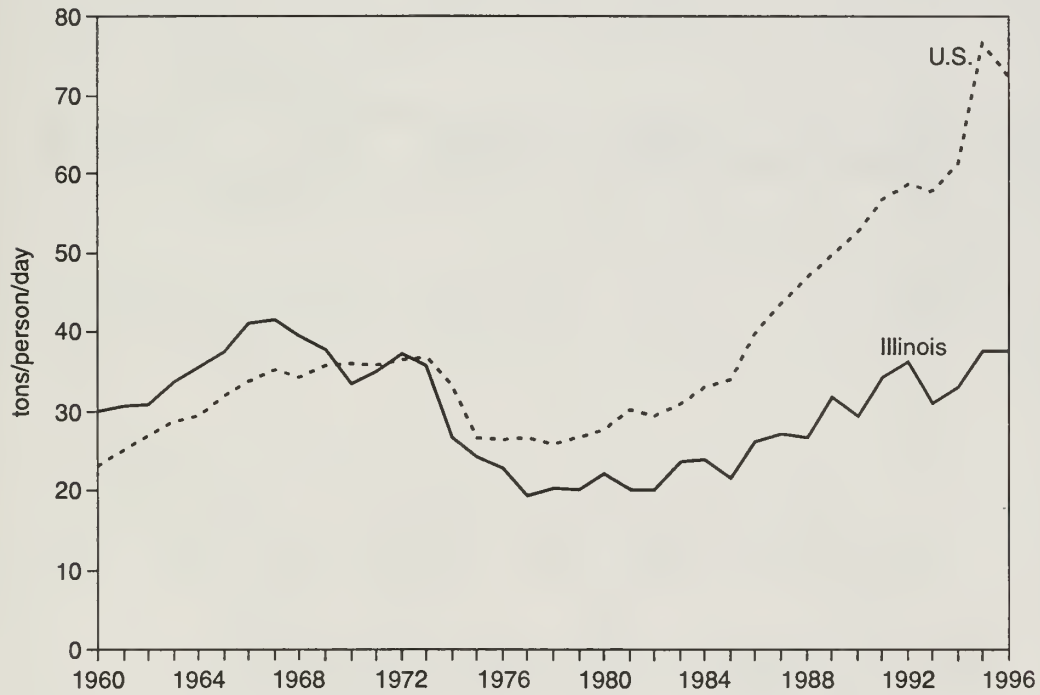

Figure 7 Trends in productivity of surface mines, 1960–1996

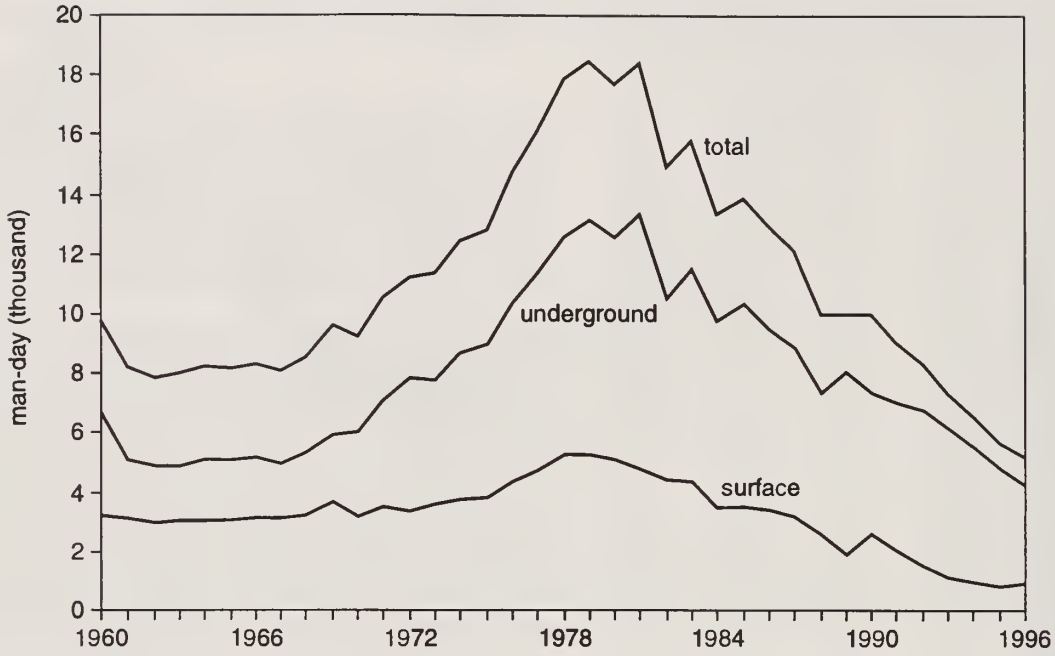

Figure 8 Employment in coal mining in Illinois, 1960–1996

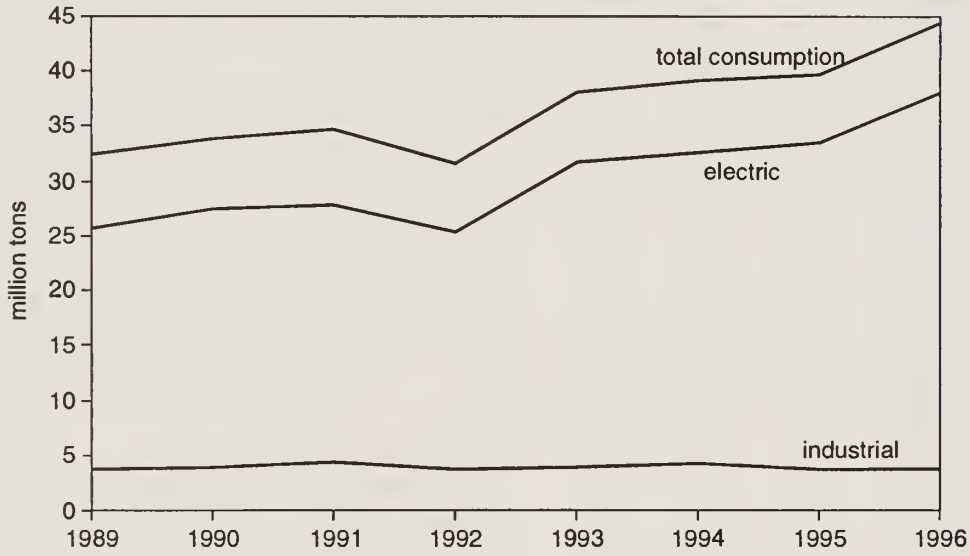

Figure 9 Consumption of coal in Illinois by major consumers, 1989–1996

Table 10 Production, distribution, consumption, and price of coal in Illinois, 1989–1996

	1989	1990	1991	1992	1993	1994	1995	1996
PRODUCTION (million short tons)								
Recoverable reserves	1,380.70	1,173.98	1,256.52	1,199.31	1,063.83	963.47	882.32	891.11
Productive capacity	NA	NA	75.71	75.79	69.32	69.41	56.63	61.73
Production total	60.13	60.39	60.26	60.33	41.10	52.80	48.18	46.66
Underground	40.53	41.67	43.13	47.48	33.10	43.28	41.12	38.95
Surface	19.60	18.72	17.12	12.85	8.00	9.52	7.06	7.71
Capacity utilization	NA	NA	80	79	59	76	85	75.58
Ratio of recoverable reserves to production	23.30	19.40	20.80	20.00	25.90	18.30	18.30	19.10
Number of miners	10,003	10,018	9,102	8,323	7,303	6,591	5,652	5,174
Productivity total (tons/miner/hr)	2.77	2.94	3.18	3.42	3.23	3.59	3.87	4.18
Underground (tons/miner/hr)	2.41	2.70	2.88	3.21	3.11	3.49	3.86	4.10
Surface (tons/miner/hr)	3.96	3.64	4.30	4.47	3.86	4.12	3.89	4.67
Imports				54	51	346	223	210
DISTRIBUTION (million short tons)								
Distribution total	59.46	60.59	58.55	58.91	42.00	52.21	47.87	47.08
Domestic distribution	58.98	60.22	57.29	57.67	41.33	51.97	45.17	45.19
within state	17.59	18.70	18.79	18.17	15.21	17.52	15.59	16.05
to other states	41.39	41.52	38.50	39.50	26.12	34.22	29.58	29.14
Foreign distribution	0.49	0.37	1.26	1.24	0.67	0.27	2.70	1.89
CONSUMPTION (million short tons)								
Consumption total	32.37	33.90	34.68	31.60	38.14	39.08	39.62	44.43
Electric utilities	25.76	27.40	27.75	25.26	31.74	32.60	33.46	38.09
Industrial	3.77	3.89	4.43	3.74	3.97	4.19	3.65	3.74
Coke	W	W	W	W	W	W	W	W
Residential/commercial	W	W	W	W	W	W	W	W
Consumer stocks total								
Electric utility	8.20	7.40	6.98	7.40	4.02	4.53	5.33	4.58
PRICE (nominal dollars per short ton)								
Mine total	28.17	27.73	28.35	27.66	25.27	23.14	23.05	22.74
Underground	28.66	28.30	29.05	27.93	25.54	23.18	22.88	23.12
Surface	27.20	26.45	26.59	26.69	24.18	22.92	24.04	20.86
Consumer								
Electric utilities	38.78	37.79	36.76	37.06	35.30	32.69	32.58	32.14
Industrial	31.17	31.28	30.81	29.24	29.42	29.13	29.03	29.69
Coke	W	W	W	W	W	W	W	W

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (1993–1996)
W = withheld NA = not available

Industrial Sand

Production Illinois ranked first in the production of industrial sand in 1996. The area best known for production of industrial (silica) sand is the Ottawa District of La Salle County (District 3), which produces from the St. Peter Sandstone of Middle Ordovician age. Within the district, the St. Peter is called the Ottawa Sand. Industrial sand is also produced in District 2 in Mason County from sand dunes formed during and after the retreat of Wisconsinan-age glaciers and in District 1 in Ogle County from the St. Peter Sandstone. The production of industrial sand in 1996 was 4.36 million tons valued at $62.6 million. The state accounted for 15.7% of the total industrial sand produced in the country in 1996 (tables 1 and 2). The average unit value of industrial sand in 1996 was $14.36 per ton.

Consumption Industrial silica sand is marketed both in ground and unground forms. Unground silica sand is used primarily in glass manufacturing. Other uses include sand for foundry sand, blasting, grinding and polishing, railroad traction, filtration, and frac sands used for propping and hydrofracturing reservoir strata in oil wells. Ground sand is used in chemicals, abrasives, enamels, pottery, porcelain, tile, and various fillers.

Unimin Corporation, U.S. Silica Company, Manley Brothers, and Fairmont Minerals Ltd. mined silica sand in the Ottawa District of La Salle County, and Unimin's Operation in Ogle County mined sand for the glass, blasting, foundry, and frac sand markets. Manito Investment Company mined Quaternary- to Holocene-age quartz-feldspar dune sand in Mason County for the foundry sand and amber-colored glass markets.

Table 11 Coal production and consumption in Illinois, 1970–1996 (million tons)

Year	Production	Consumption
1970	33.98	42.31
1971	28.54	38.29
1972	31.33	42.03
1973	29.08	40.63
1974	26.37	39.05
1975	26.04	41.95
1976	24.97	41.46
1977	21.77	38.30
1978	20.51	38.70
1979	21.74	42.72
1980	21.58	42.11
1981	17.00	36.58
1982	19.18	36.34
1983	18.79	36.33
1984	20.84	38.80
1985	19.00	37.02
1986	19.00	38.09
1987	18.61	35.36
1988	17.25	32.88
1989	17.56	30.12
1990	18.70	33.90
1991	18.79	34.68
1992	18.17	31.60
1993	15.21	38.14
1994	17.52	39.08
1995	15.59	39.62
1996	16.05	44.47

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (various volumes)

Stone

Among the non-fuel minerals produced in Illinois, stone is the most important in terms of total value. In 1996, the state ranked fifth among the stone-producing states. Crushed stone accounted for 63.9% of the total value of non-fuel minerals and 19% of the total value of minerals produced in the state in 1996 (table 1).

Production Although production of crushed stone is fairly evenly distributed throughout the state (fig. 17), the greatest quantities are produced in District 1. In 1996, the state produced 66.50 million tons of crushed stone worth $364 million. Since 1990, stone production has hovered around 60 to 65 million tons. In 1995, it fell marginally by about 1.9% from 62.6 million tons in 1994 to 61.4 million tons (fig. 16). In 1996, 127 quarries produced 57.70 million tons of limestone worth $319 million, and 19 quarries produced 8.80 million tons of dolomite worth $45 million. The dolomite-producing counties are Cook, Kankakee, Will, Clark, Kane, De Kalb, Stephenson, Whiteside, Lee, and Winnebago. In addition to crushed limestone and dolomite, about 1.5 million tons of miscellaneous stones worth $2.836 million were produced in Illinois in 1994.

Stone, a bulk commodity, is primarily transported by truck. Other methods of transportation are by rail and barge. Crushed stone is barged to in-state destinations as well as to Pennsylvania and Gulf Coast markets in Alabama, Texas, and Louisiana. Stone produced in Illinois is also used for

ballasting the track of the entire Illinois Central Railroad network.

Consumption Stone is primarily used as a construction aggregate in portland cement concrete and bituminous concrete highway construction, and as road-base stone. In addition to uses for construction purposes, limestone and dolomite have chemical, agricultural, and environmental uses.

In 1996, about 9.6 million tons of stone valued at $42.9 million were used in highway construction as graded road base or sub-base, about 2.36 million tons of crushed stone valued at $9.08 million were used in the manufacture of cement, and about 2.5 million tons of stone valued at $11.1 million were used as agricultural limestone in crop production (USGS, Mineral Industry Surveys, Illinois, 1997 Annual Review). Agricultural limestone is often produced from the fines generated when limestone is crushed for aggregate; it is used by farmers to neutralize the acidifying effect of nitrogen fertilizers used in corn production.

Table 12 Average mine price of coal in Illinois and the U.S., 1984–1996

	Illinois		U.S. total	
Year	Nominal	Real	Nominal	Real
1985	30.80	32.65	25.20	26.72
1986	29.99	30.88	23.79	24.50
1987	29.56	29.56	23.07	23.07
1988	28.55	27.56	22.07	21.30
1989	28.17	26.10	21.82	20.21
1990	27.73	24.62	21.76	19.32
1991	28.35	24.21	21.49	18.35
1992	27.66	22.99	21.03	17.48
1993	25.27	20.47	19.85	16.08
1994	23.13	18.33	19.41	15.38
1995	23.05	17.80	18.83	14.54
1996	22.74	17.23	18.45	13.98

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (various volumes). Nominal prices are in dollars per short ton; real prices are in 1987 dollars.

Clays

Production Shale, absorbent clay (fullers' earth), and common clays are mined in Illinois. Absorbent clay is mined from the Paleocene-age Porters Creek Formation to produce absorbent clay products such as pet litter products and floor-sweep materials for cleanup. In Illinois, Quaternary till deposits and Pennsylvanian claystones and shales are mined to produce common clay for brick manufacture. Common clay is defined as clay or clay-like material that is sufficiently plastic to permit ready molding.

In 1996, Illinois produced about 0.79 million tons of common clay worth about $0.63 million. Clay production in 1996 increased by about 57% from its level in 1995 (0.50 million tons). The average value of clay produced in Illinois in 1995 was $2.42 per ton. Production of clay in the state has increased in recent years (fig. 18). In addition to common clay, Illinois is a significant producer of absorbent clay, but figures for production and value of absorbent clay produced in the state are not available.

Uses Common clays and shales mined in Illinois are used to manufacture bricks, drain tiles, dinnerware, and cement. About 50% of the common clay produced in the country is used in the manufacture of brick; portland cement production accounts for 27%, and the rest goes into other miscellaneous uses (USGS, Mineral Industry Surveys, Clay 1997 Annual Review). Absorbent clay is used in pet litter and oil-sweep compounds, as a filler and pelletizer in animal feeds, as a decolorizer of oils, and as foundry sand binder.

Fluorspar

Fluorspar is the state mineral of Illinois. The first recorded fluorspar mining in Illinois was in 1842 when a small operation was started in Hardin County. Illinois has long been the principal producer in the country. The production centered around Hardin County in southern Illinois. Production rose from 104.7 thousand tons in 1940 to 198.7 thousand tons in 1943. In 1940, about 48% of the nation's fluorspar demands was met by the shipments from Illinois. The state's share increased to 51% in 1943 but has been falling since then. In the early days, fluorspar output came from numerous mines ranging from those producing only a few hundred tons per year to those producing tens of

Table 13 Distribution of coal produced in Illinois, 1985–1996 (thousand short tons)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EAST NORTH CENTRAL	30,171	31,765	31,948	29,117	28,757	30,701	29,021	29,271	20,483	28,299	25,629	25,315
Illinois	18,995	18,996	18,614	17,250	17,588	18,700	18,787	18,167	15,206	17,517	15,587	16,052
Indiana	9,262	10,871	11,087	9,508	9,508	10,571	9,185	9,595	4,541	9,574	8,559	8,178
Michigan	41	31	203	30	10	10	5	6		51	70	59
Ohio				12	2	58	73			18	1	18
Wisconsin	1,872	1,867	2,044	2,317	1,649	1,362	971	1,053	736	1,139	1,412	1,008
WEST NORTH CENTRAL	17,439				16,977	16,397	15,470	13,499	7,783	9,448	6,270	5,346
Iowa	2,385	2,224	2,020	2,530	2,362	1,592	1,473	1,175	1,534	1,535	1,216	694
Kansas and Nebraska	484	261	429	603	612	1,157	1,320	640	179	193		
Minnesota	281	138	123	55	47	41	40	58	43	179	111	100
Missouri	14,288	13,716	13,743	13,656	13,956	13,067	12,637	11,625	6,027	7,541	4,815	4,403
North and South Dakota												
SOUTH ATLANTIC	6,854	6,318	9,140	9,791	9,055	9,019	8,811	10,485	8,137	8,403	6,642	7,255
Florida	3,723	3,915	3,583	4,208	3,814	4,150	4,464	5,529	4,782	5,846	6,058	6,052
Georgia	3,131	2,403	5,557	5,583	5,241	4,869	4,347	4,955	3,355	2,557	584	1,204
South Carolina												
EAST SOUTH CENTRAL	4,492	6,643	1,997	2,514	4,015	4,482	3,681	4,780	4,823	5,453	6,511	7,130
Alabama	2,819	2,592		314	768	813	474	632	401	750	1,146	2,155
Kentucky	125	847	61	136	424	453	15	7	535	343	274	
Mississippi	152	374	712	743	1,293	1,218	1,518	1,879	1,106	1,164	1,304	1,749
Tennessee	1,395	2,830	1,224	1,321	1,530	1,998	1,673	2,261	2,780	3,195	3,787	3,225
WEST SOUTH CENTRAL	38	148	106	110	105	82	99	81	58	46	76	86
Arkansas		136	87	82	98	82	99	81	37	30	76	76
Louisiana	10	12	3		1				21			
Oklahoma					5					16		10
Texas			16	28								
MOUNTAIN						11	201					
Montana							201					
Wyoming						11						
OTHER STATES	1	8	1	1	10						23	40
TOTAL DOMESTIC					58,986	60,222	57,290	57,670	41,330	51,973	45,170	45,190
EXPORTS					488	370	1263	1242	670	236	2700	1,886
TOTAL	59,171	61,493	58,899	58,901	59,464	60,592	58,553	58,912	42,000	52,209	47,870	47,076

Source: Energy Information Administration, U.S. Department of Energy, Coal Industry Annual (various volumes)

Table 14 Domestic distribution of Illinois coal to electric utilities by state, 1991–1997 (thousand short tons)

	Alabama	Florida	Georgia	Illinois	Indiana	Iowa	Kansas	Kentucky	Michigan	Minnesota	Mississippi	Missouri	Ohio	Tennessee	Wisconsin	TOTAL
1991	1,030	4,637	5,055	15,870	8,452	1,336	1,485	15		53	1,340	12,438		2,357	761	54,831
1992	956	5,504	5,137	14,818	9,565	1,417	767	7		63	1,239	11,376		2,831	823	54,504
1993	763	5,406	3,345	12,594	6,338	442	302	433		43	1,080	5,415		37,773	445	40,378
1994	1,137	5,544	2,543	14,314	10,556	1,219	305	440	51	94	1,063	6,990	1	3,151	900	48,308
1995	980	5,961	604	11,879	10,661	770	138	285	42	36	1,236	4,168		3,949	1,232	41,941
1996	1,723	6,392	1,203	13,365	9,007	164	207	75	29	69	1,703	3,924	9	3,756	756	42,382
1997	1,557	6,015	1,033	14,315	4,788	288	129	504		114	1,149	2,652		1,918	719	35,182

Source: Energy Information Administration, U.S. Department of Energy, Quarterly Coal Reports (various volumes)

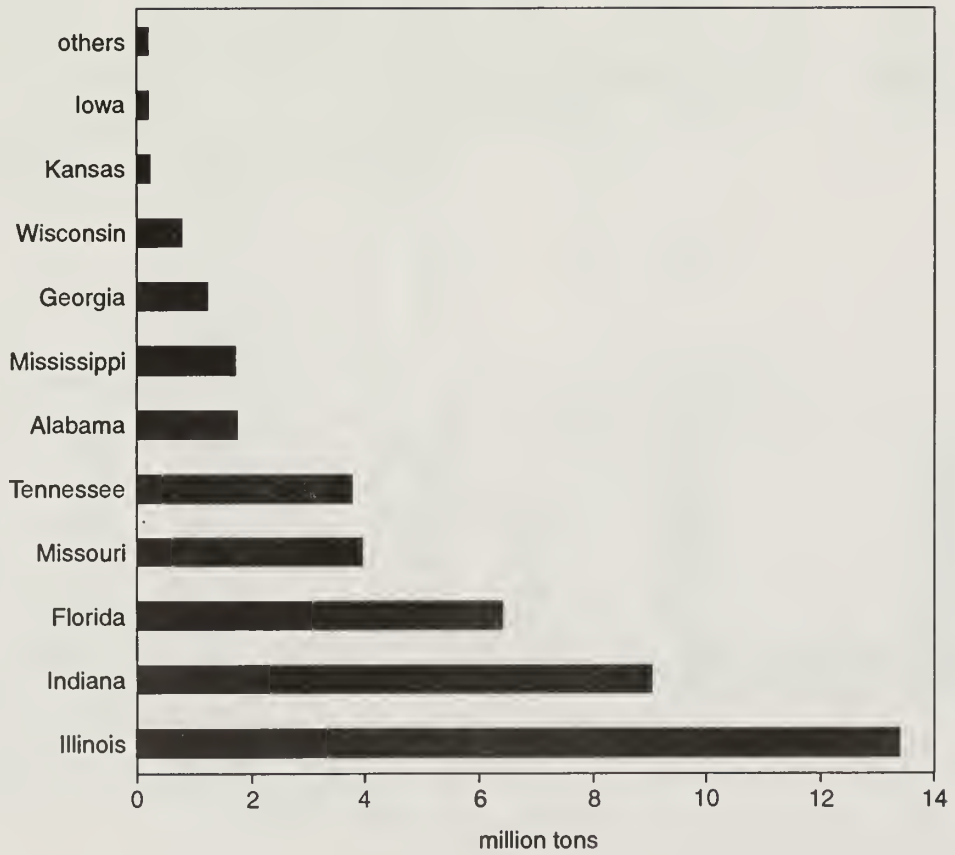

Figure 10 Domestic distribution of Illinois coal to electric utilities by state, 1996

Table 15 Sources of coal consumed by electric utility plants in Illinois, 1991–1997 (thousand short tons)

	Illinois	Colorado	Indiana	Kentucky	Montana	Ohio	Utah	W. Virginia	Wyoming	Other states	TOTAL
1991	15,870	336	1,616	1,434	3,228			721	3,598	10	26,813
1992	14,818	470	826	1,187	3,036		239	492	4,382		25,449
1993	12,594	1,095	1,368	1,602	3,249	54	198	422	7,509		28,091
1994	14,314	1,371	1,221	1,351	4,240	35	235	243	9,927		32,936
1995	11,879	1,526	1,040	1,027	2,685		1,648	19	14,081		33,905
1996	13,365	803	1,173	391	2,162		1,846		17,701		37,441
1997	14,315	1,135	1,708	226	1,572		1,377	47	20,370		40,750

Source: Energy Information Administration, U.S. Department of Energy, Quarterly Coal Reports (various volumes)

Table 16 Cost and quality of coal received by electric utility plants, 1990–1996

	Illinois coal					Wyoming coal					Average for all coal received				
Year	Btu/pound	Sulfur (%)	Ash (%)	Cents/mm Btu	$/s. ton	Btu/pound	Sulfur (%)	Ash (%)	Cents/mm Btu	$/s. ton	Btu/pound	Sulfur (%)	Ash (%)	Cents/mm Btu	$/s. ton
1990	11,642	2.81	8.84	205.5	47.84	8,389	0.43	5.33	167.5	28.11	11,910	1.38	8.01	174.2	41.48
1991	11,682	2.78	8.83	205.3	47.97	8,457	0.41	5.20	152.0	25.71	11,862	1.34	7.86	171.9	40.78
1992	11,729	2.79	8.55	190.4	44.67	8,388	0.45	5.28	145.7	24.44	11,777	1.31	7.97	167.0	39.32
1993	11,738	2.56	8.43	174.6	40.99	8,360	0.42	5.25	148.6	24.85	11,685	1.20	7.75	164.7	38.49
1994	11,616	2.44	8.40	164.4	38.19	8,466	0.36	4.94	149.3	25.28	11,642	1.13	7.83	161.8	37.66
1995	11,754	1.95	7.81	170.7	40.12	8,502	0.34	5.01	152.7	25.96	11,539	0.98	7.68	161.2	37.21
1996	11,865	1.84	7.47	170.4	40.43	8,527	0.38	5.12	154.7	26.39	11,520	0.98	7.50	158.1	36.44

Source: Energy Information Administration, U.S. Department of Energy, Quarterly Coal Report (various volumes)
Costs are average delivered costs at the utility.

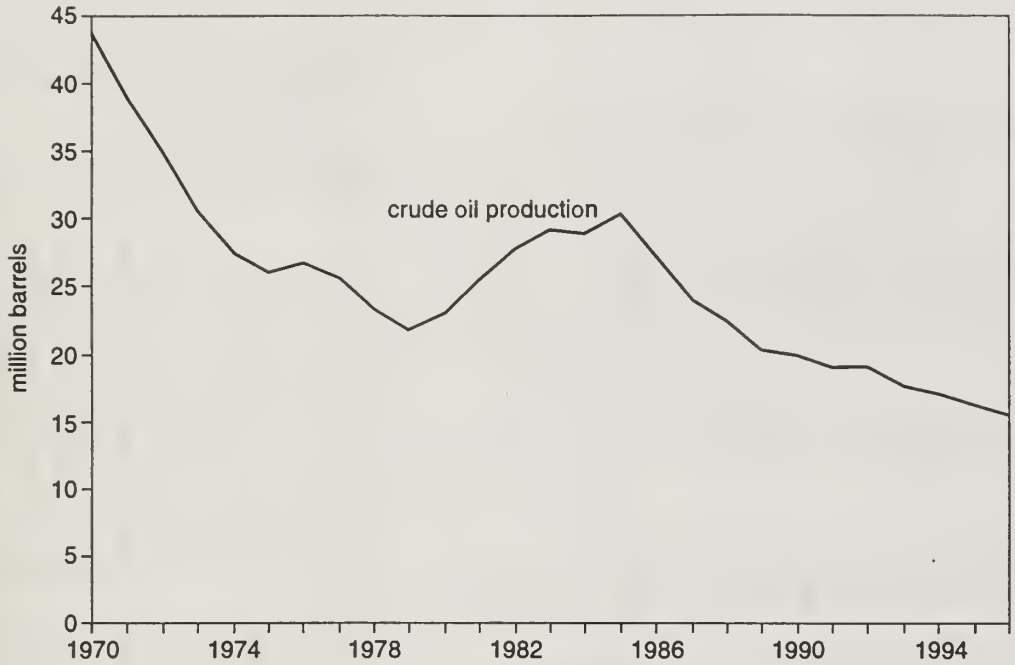

Figure 11 Production of crude oil in Illinois, 1970–1996

thousands of tons annually. The extremely competitive conditions and high cost of production have forced most of the producers out of business over time.

In 1995, Ozark-Mahoning Co., a subsidiary of the Pennsylvania-based Elf Atochem North America Inc., was the nation's only fluorspar producer. Total shipments of fluorspar in 1995 from this company were 48,000 tons, which accounted for 8.5% of the nation's fluorspar requirements. Elf Atochem North America announced the closure of its two mines and a flotation plant in Hardin County in late 1995 and laid off 103 workers effective January 31, 1996. The reasons given for the shutdown were depletion of reserves at active mines and competition from China. Ozark-Mahoning was the last active fluorspar mining company in the country and had been in operation in southern Illinois since late 1938. The company was down to one employee in 1996, who supervised the environmental remediation work and the sale of company property and assets. Hastie Mining and Trucking Co., a local quarry company, leased Ozark-Mahoning's mineral drying and bagging facilities to process fluorspar purchased from the National Defense Stockpile. The company will probably service some of the former customers of Ozark-Mahoning by making a calcined product. With the closure of Ozark-Mahoning Company's operations, the United States ended 158 years of mining fluorspar.

Barite, copper, lead, silver, and zinc (sphalerite) concentrates were recovered as coproducts of fluorspar processing in Illinois. Fluosilicic acid, a byproduct, was also recovered from fluorspar processing. It was used primarily in the aluminum industry for making aluminum fluoride and in water fluoridation, either directly or after processing to sodium silicofluoride.

Uses Acid-grade fluorspar, containing greater than 97% calcium fluoride, is used primarily as a feedstock in the manufacture of hydrogen fluoride and to produce aluminum fluoride. Ceramic-grade fluorspar (85% to 95% CaF_2) is used for the production of glass and enamel, to make

Table 17 Crude oil production from major oil fields (more than 200,000 bbl/yr) in Illinois, 1993–1996

Field	County	1993 Production (1,000 bbl)	1993 % of Illinois total	1994 Production (1,000 bbl)	1994 % of Illinois total	1995 Production (1,000 bbl)	1995 % of Illinois total	1996 Production (1,000 bbl)	1996 % of Illinois total
Clay City Consolidated	Clay	1,912.20	10.79	1,813.04	10.57	1,333.63	8.24	1,145.83	7.36
Enfield South	White			251.50	1.47	225.30	1.39	238.43	1.53
Johnsonville Consolidated	Wayne	574.44	3.24	650.12	3.79	713.32	4.41	512.29	3.29
Lawrence	Lawrence	2,371.34	13.38	2,208.96	12.88	2,013.31	12.44	1,816.39	11.66
Louden	Fayette	911.76	5.14	892.93	5.21	929.87	5.74	915.68	5.88
Main Consolidated	Crawford	1,801.91	10.17	1,378.05	8.04	1,185.75	7.32	1,080.97	6.94
New Harmony Consolidated	White	750.91	4.24	697.02	4.06	666.17	4.11	650.60	4.18
Philipstown Consolidated	White	374.03	2.11	344.51	2.01	349.06	2.16	303.00	1.95
Roland Consolidated	White	272.65	1.54	239.22	1.40	200.96	1.24	226.29	1.45
Sailor Springs Consolidated	Clay	323.43	1.82	329.46	1.92	284.61	1.76	267.17	1.72
Salem Consolidated	Marion	965.88	5.45	935.56	5.46	917.90	5.67	941.49	6.04
TOTAL		10,458.56	59.00	9,740.40	56.80	8,819.89	54.48	8,098.15	51.99

Source: Illinois State Geological Survey

Table 18 Petroleum products consumed in Illinois, 1980–1995 (million barrels)

Product	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Motor gasoline	109.06	107.30	105.17	106.96	105.08	111.09	108.64	110.25	116.20	115.49	120.42	104.35	106.32	109.55	111.29	111.21
Kerosine	0.61	0.67	0.44	0.64	0.64	0.76	0.40	0.30	0.35	0.37	0.17	0.20	0.14	0.18	0.20	0.29
Distillate fuel oil	36.70	34.51	32.57	34.79	36.42	32.19	35.13	34.13	33.66	34.56	42.53	36.15	36.38	38.38	33.95	37.53
Residual fuel oil	28.27	20.79	15.47	13.70	9.85	6.51	8.32	6.96	5.91	4.05	3.62	3.45	2.35	2.28	2.71	1.46
Lubricants	3.47	3.33	3.04	3.18	3.39	3.16	3.09	3.49	3.37	3.46	3.56	3.18	3.24	3.30	3.45	3.39
Liquified gases (LPG)	38.81	34.15	26.87	27.04	26.07	27.17	32.53	41.88	45.34	12.39	12.47	14.54	12.48	21.65	24.71	25.82
Asphalt and road oil	8.09	6.09	4.86	5.36	5.73	7.50	6.18	6.32	5.60	8.05	8.34	7.92	9.29	6.31	7.80	7.46
Aviation gasoline	0.13	0.27	0.22	0.23	0.20	0.21	0.21	0.16	0.19	0.19	0.16	0.18	0.18	0.23	0.20	0.22
Jet fuel	19.66	16.93	16.64	15.94	2.69	2.75	2.05	2.00	3.96	4.50	3.95	6.44	7.40	9.17	9.62	10.36
Other	29.43	20.96	19.23	20.99	21.31	20.05	23.66	25.51	28.28	28.14	30.69	28.80	32.66	31.43	36.70	34.91
TOTAL	274.24	244.99	224.50	228.83	211.37	211.38	220.42	231.20	243.05	211.40	226.14	208.72	214.11	226.13	230.64	232.65

Source: Energy Information Administration, U.S. Department of Energy, State Energy Data Report, 1995

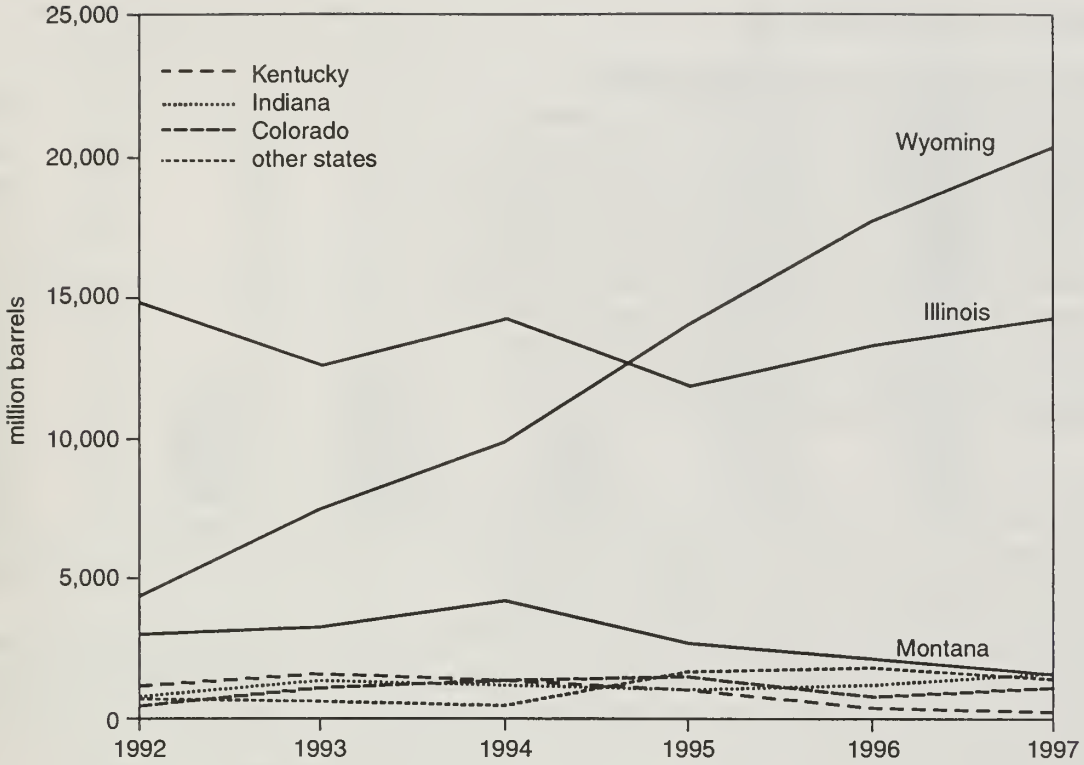

Figure 12 Petroleum products consumed in Illinois, 1992–1995

welding rod coatings, and as a flux[1] in the steel industry. Metallurgical-grade fluorspar (65% to 85% CaF_2) is used primarily as a fluxing agent in the steel industry.

The reported domestic consumption by the hydrogen fluoride industry increased by nearly 4% in 1996. The reported consumption by the non–hydrogen fluoride industries decreased by 19% from its level in 1995 (USGS, Mineral Industry Surveys, Fluorspar 1997 Annual Review). In the ceramic industry, fluorspar was used as a flux and as an opacifier in the production of flint glass, white or opal glass, and enamels.

Tripoli

The term *tripoli* refers to microcrystalline silica. Among the producing states, Illinois ranks first in tripoli production with about 70% of the national output. For reasons of confidentiality, the production figures cannot be revealed here. Unimin Specialty Minerals Inc., a division of Unimin Corporation located in Alexander County in southern Illinois, is the only producer of high-grade tripoli in Illinois.

Tripoli processed in Illinois is used as filler in paints, plastics, and rubber products and as an abrasive in buffing and polishing compounds, soap, and toothpaste. Some iron-stained tripoli is being used in the manufacture of portland cement.

[1] A flux is a substance used to remove the impurities from steel. It combines with the impurities in the steel to form a compound with a lower melting point and density than steel, which tends to float to the top and can be easily poured off and separated from the molten steel.

Metals and Other Minerals

Steel, Zinc, Lead, Silver, and Copper

Raw steel was produced in Illinois, but was processed from materials obtained from other domestic and foreign sources. In 1996, Illinois ranked fourth in the nation in the manufacture of raw steel with an estimated output of 7.4 million metric tons (8.2 million short tons), according to the American Iron and Steel Institute. Zinc, lead, silver, and copper were produced in small quantities as byproducts of the fluorspar mining industry. With the closure of fluorspar mines, these metals are no longer produced in significant quantities in Illinois.

Table 19 Production of natural gas in Illinois (million cu ft), 1985–1996

Year	Gas wells	Oil wells	Total
1985	1,228	96	1,324
1986	1,546	342	1,888
1987	1,215	156	1,371
1988	1,290	181	1,471
1989	1,268	209	1,477
1990	653	24	677
1991	453	13	466
1992	336	10	347
1993	330	10	340
1994	323	10	333
1995	315	11	320
1996	282	9	291

Source: Illinois State Geological Survey

Peat

All commercial sales of peat in the United States (excluding imports) are for agricultural and horticultural purposes. Three types of peat are produced in Illinois: reed sedge, moss, and peat moss. In 1996, four Illinois companies produced peat: Dahl Enterprises and Roots Peat Farm in Lake County, and Hyponex Corporation and Markman Peat Company in Whiteside County. Illinois ranked third among 20 states in production of peat. Peat is sold as bulk and packaged peat. More than 99% of the state's peat was sold in package form for general soil improvement (USGS, Mineral Industry Surveys, Peat 1997 Annual Review). Small amounts were sold in bulk form to nurseries and for earthworm cultivation.

Gemstones

During 1995 Illinois produced gemstones worth $0.27 million (table 1). Production is limited to specimen-grade fluorite and accessory minerals. With the closing of the fluorspar mine in late 1995, the quantity and value of gemstones produced are expected to become insignificant.

MINERALS PROCESSED

Minerals extracted mainly in other states or foreign countries but processed in Illinois include ground barite, calcined gypsum, crude iodine, iron-oxide pigments, natural gas liquids, expanded perlite, pig iron, sulfur, exfoliated vermiculite, primary slab zinc, and secondary slab zinc. The value of these processed minerals is unavailable because some companies declined to provide the needed information.

Table 20 Natural gas production from relatively large fields in Illinois, 1990–1996 (million cu ft)

Gas field	County	1990	1991	1992	1993	1994	1995	1996
Liberty	Adams	181.70	41.30			12.00		
Stolletown	Clinton	33.30	18.80		9.80			
Mattoon	Coles	60.60	32.90	41.10	20.59	16.01	34.07*	14.35
Ashmore East	Edgar	28.20	21.50	26.70	36.52	21.78		13.94
Omaha	Gallatin	58.30	81.00	83.00	42.60	34.59	14.61	11.29
St. Libory	St. Clair	104.60	95.10	93.70	93.80	106.86	139.00	62.30
Eldorado West	Saline	38.40	38.50	44.20	42.57	35.80	42.13	48.47
Harco East	Saline			37.70				
Raleigh East	Saline					26.53	20.89	18.56
Pittsburg	Williamson	133.90	101.50					
Other		37.90	35.50	19.30	4.26			
TOTAL		676.90	466.10	345.70	250.13	253.56	216.63	168.92

Source: Illinois State Geological Survey
* Total of Coles and Edgar Counties

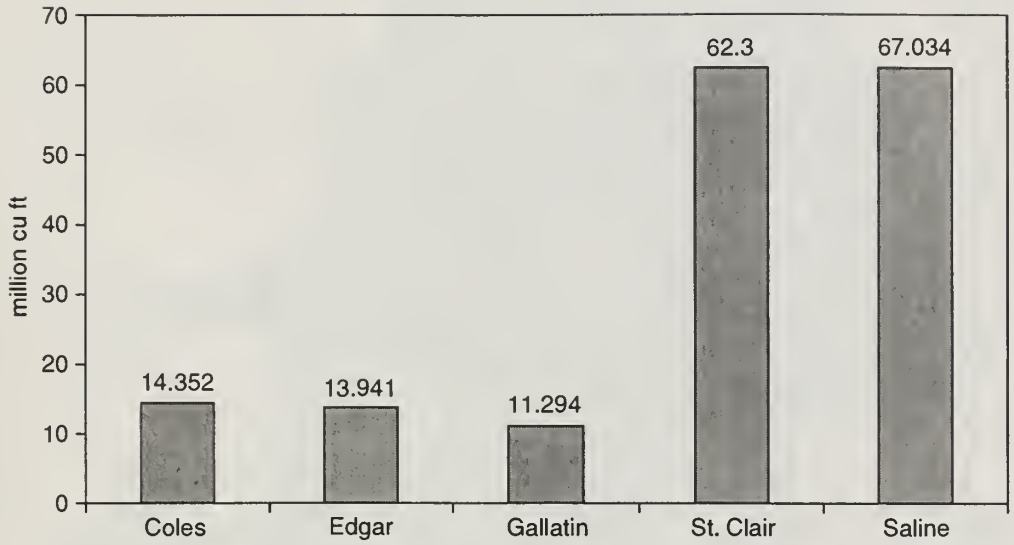

Figure 13 Production of natural gas from large fields by counties, 1996

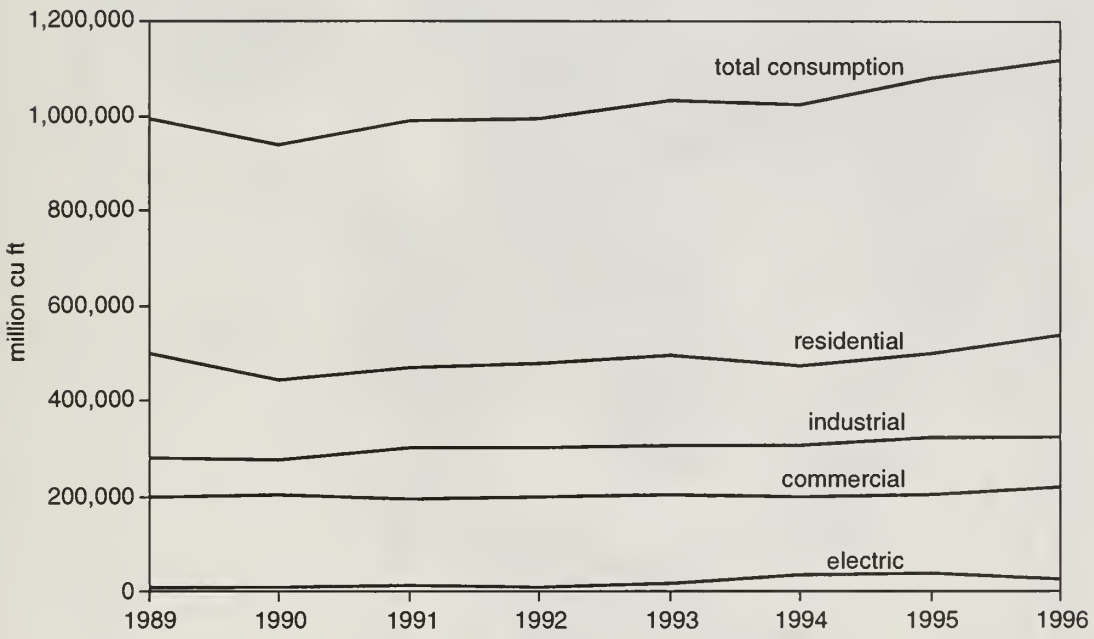

Figure 14 Consumption of natural gas in Illinois, 1989–1996

Table 21 Natural gas production, consumption, and average price in Illinois, 1989–1996

	1989	1990	1991	1992	1993	1994	1995	1996
PRODUCTION (million cu ft)								
Gross withdrawals								
Gas wells	1,268	653	453	337	330	323	325	289
Oil wells	209	24	13	10	10	10	10	9
TOTAL	1,477	677	466	347	340	333	335	298
CONSUMPTION (million cu ft)								
Lease fuel	35	22	10	9	10	10	7	7
Pipeline fuel	13,531	12,111	11,070	11,330	11,620	13,808	13,208	14,388
Plant fuel	17	109	132	98	106	101	90	75
Delivered to consumers								
Residential	499,984	442,163	466,970	475,360	495,311	473,788	500,798	538,749
Commercial	196,171	200,267	193,844	196,964	203,157	197,576	203,802	218,054
Industrial	278,826	275,630	302,691	300,366	305,014	305,092	321,465	322,275
Vehicle fuel	NA	5	7	8	12	29	31	32
Electric utilities	6,967	9,195	12,865	9,293	16,022	34,505	39,143	25,863
Total delivered to consumers	981,948	927,261	976,377	981,991	1,019,517	1,010,989	1,065,238	1,104,972
TOTAL	995,532	939,502	987,589	993,428	1,031,253	1,024,908	1,078,543	1,119,443
AVERAGE PRICE (dollars per thousand cu ft)								
Wellhead (marketed)	2.15	2.11	2.17	2.15	2.30	2.40	1.80	NA
Pipeline fuel	2.17	2.06	2.29	2.44	1.97	1.88	1.66	2.63
City gate	NA	3.09	2.91	3.20	3.30	3.02	2.59	3.27
Residential	4.92	5.06	4.95	5.09	5.52	3.02	4.66	5.28
Commercial	4.55	4.64	4.56	4.65	5.10	5.12	4.43	4.92
Industrial	3.73	4.10	3.77	3.75	4.44	4.39	3.57	4.12
Vehicle fuel	NA	4.50	3.41	3.80	4.04	3.26	2.89	3.44
Electric utilities	3.32	2.73	2.14	2.24	2.48	2.04	1.71	2.62

Source: Energy Information Administration, U.S. Department of Energy, Natural Gas Annual
NA = not available

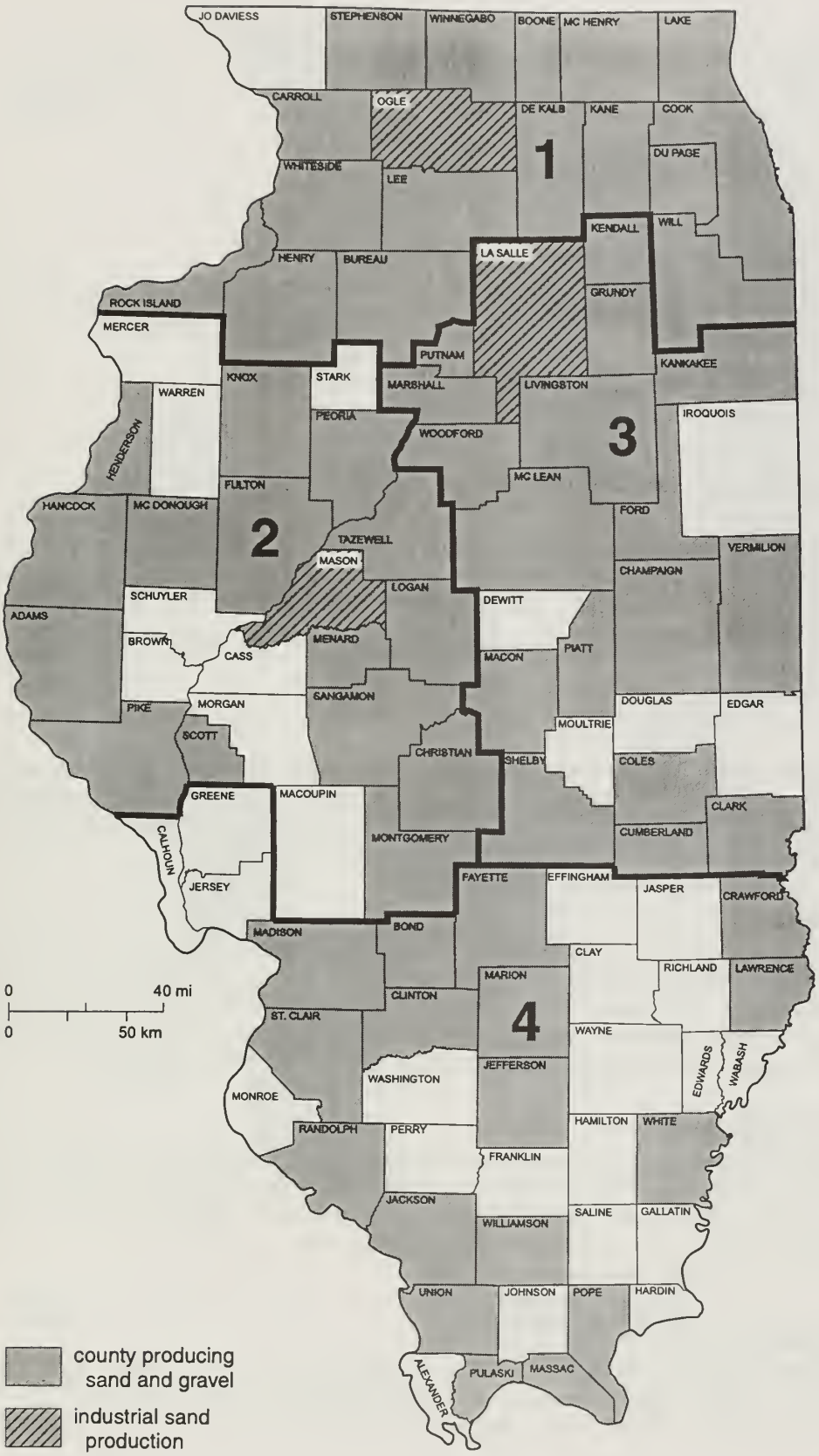

Figure 15 Districts and counties producing sand and gravel in 1996

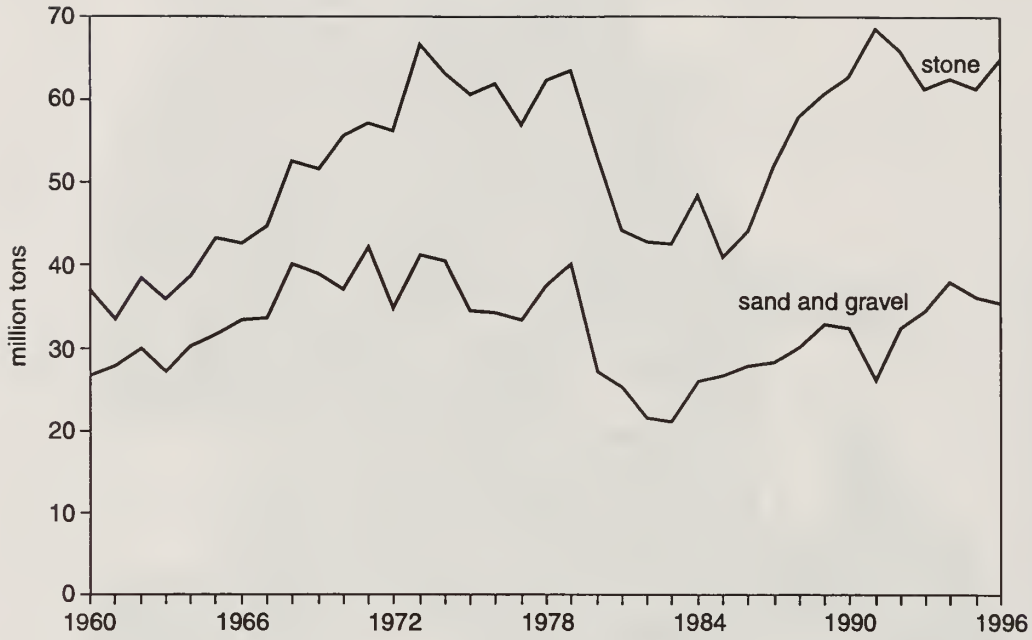

Figure 16 Production of sand and gravel and stone in Illinois, 1960–1996

Barite

Barite was produced as a byproduct of fluorspar by Ozark-Mahoning Co. until they closed their mines in late 1995. The ground barite processed in Illinois was used as a filler and extender in paints, and also in the drilling of oil and gas wells. The quantity and value of barite produced in Illinois in 1994 dropped by 9.3% from their levels in 1993.

Crude Iodine

Crude iodine is processed into inorganic compounds for commercial use at three Illinois plants: Allied Signal Company in Metropolis, Massac County; West Agro in Des Plaines, Cook County; and Echolab in Joliet, Will County. The end uses of crude iodine are in sanitation (39%), pharmaceuticals (24%), heat stabilizers (13%), catalysts (9%), animal feeds (7%), and other miscellaneous uses (USGS, Mineral Industry Surveys, Crude Iodine 1997 Annual Review).

Iron-Oxide Pigments

Finished pigments were produced from iron ore imported from other states. The producers of iron-oxide pigments were Harcos Pigments, East St. Louis; Prince Manufacturing Co., Quincy; and Solomon Grind-Chem Services Inc., Springfield. The types of iron-oxide pigments produced are black (magnetite), brown iron oxide, red iron oxide, and yellow iron oxide. Synthetic black, brown, red, and yellow iron oxides were also produced.

Natural Gas Liquids

Natural gas liquids processed include ethane, propane, isobutane, unsplit butane, and a combination of gasoline and liquified petroleum gas. Natural gas liquids were processed in Douglas County by the U.S. Industrial and Chemical Company, a Division of the Millenium Petro-Chemicals Company.

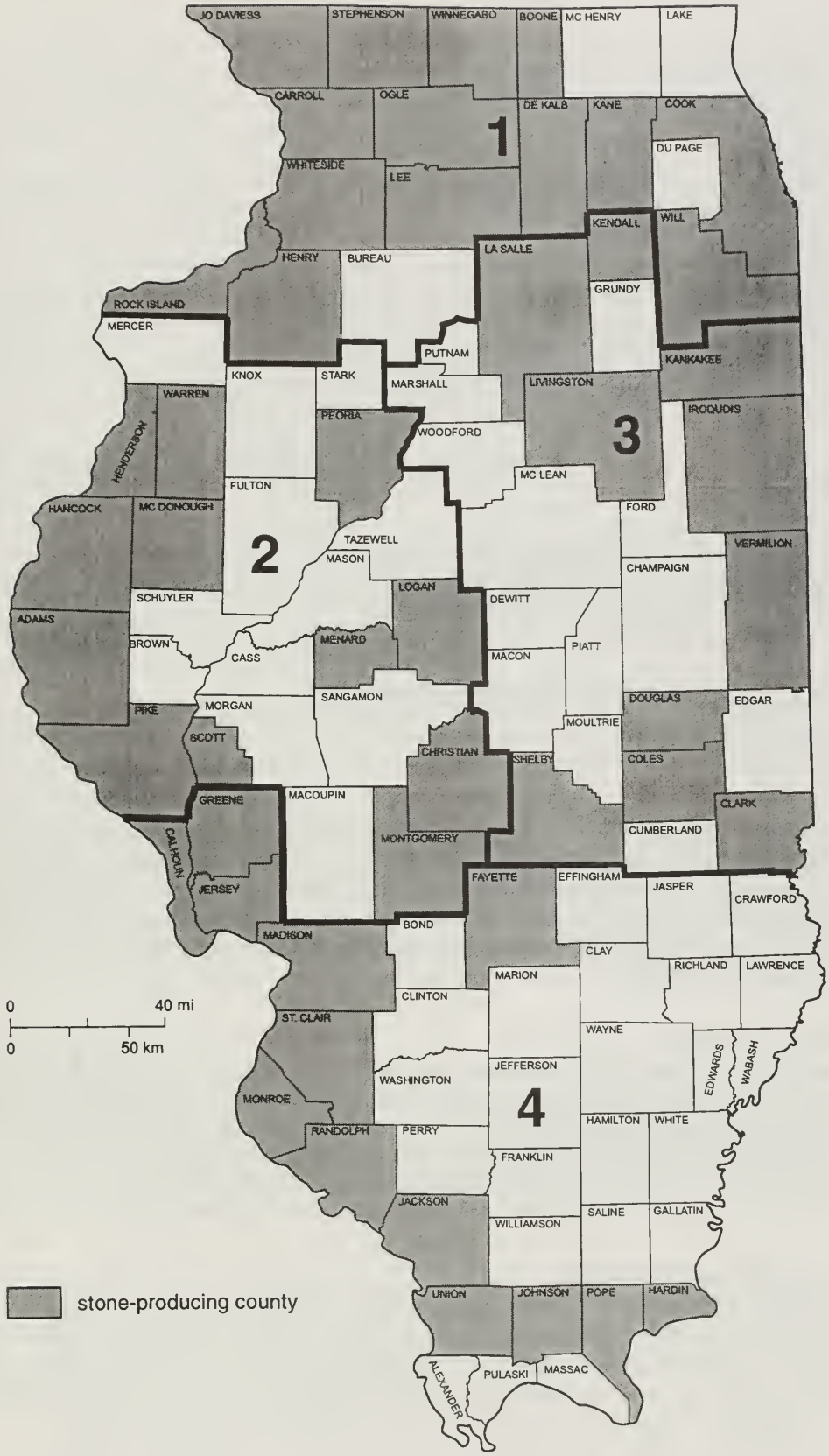

Figure 17 Districts and counties producing stone in 1996

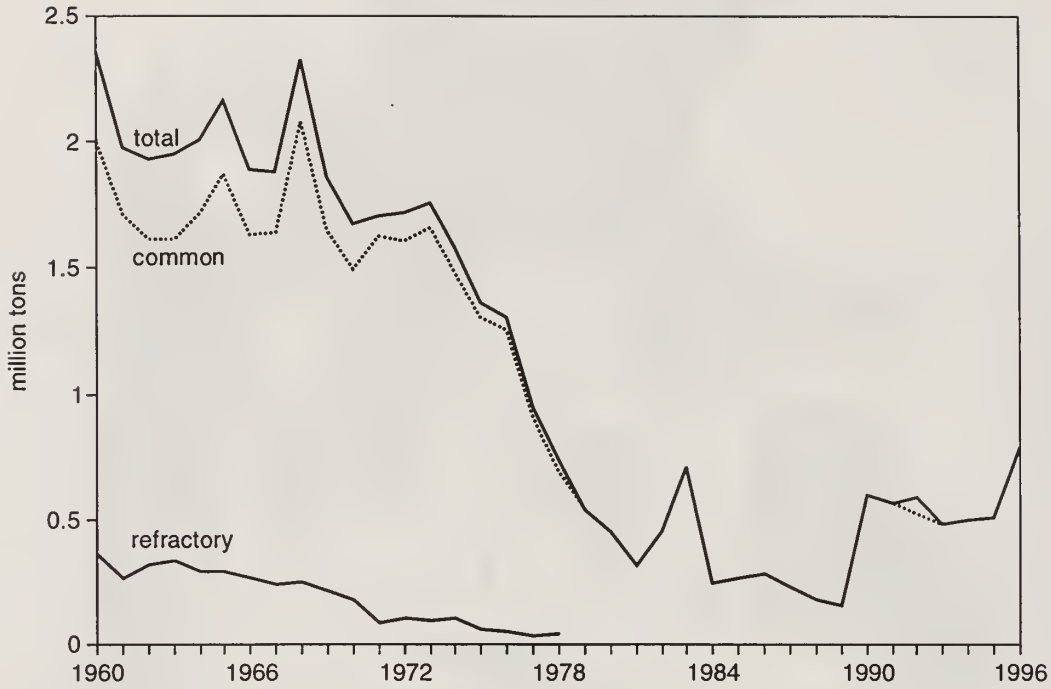

Figure 18 Trends in production of clay in Illinois, 1960–1996

Expanded Perlite

Crude perlite mined outside the state is processed to expanded (processed) perlite by three companies: Silbrico Corporation in Cook County, Illinois Strong-Lite Corporation in La Salle County, and Manville Products Corporation in Will County. Illinois ranked third (after Georgia and Mississippi) among the states in the quantity of expanded perlite sold and used. Expanded perlite is mostly used for acoustic ceiling tile, pipe and roof insulation, concrete aggregates, fillers, filter aid, and horticultural aggregate.

Slag (Iron and Steel)

Slag is used mostly as construction aggregate and road-base material in asphaltic concrete, as railroad ballast, as fill-sand, and for the manufacture of mineral wool. In 1996, three companies, Hecket Multiserv Co., International Mill Service, and Lafarge Corp., were operating nine plants in Illinois. Hecket Multiserv operated three plants in Cook County and one plant at Sterling in Whiteside County. International Mill Service had two plants in Madison County and one plant each in Kankakee and Cook Counties. Lafarge operated one plant in Madison County.

Recovered Elemental Sulfur

In 1995, 0.33 million tons of sulfur were produced in Illinois. Illinois ranked seventh in production of elemental sulfur in 1995. Four companies in three counties, Crawford, Madison, and Will, produced sulfur as a byproduct of their oil refinery operations. Sulfur differs from most other mineral commodities in its primary use as a chemical reagent rather than as a component of a finished product. The largest use is as sulfuric acid in the manufacture of phosphatic fertilizers.

Zinc

There are three primary zinc refineries in the country, including one in Illinois: the Big River Zinc Company at Sauget in St. Clair County. The Illinois Smelting Company in Cook County processed secondary slab zinc (USGS, Mineral Industry Surveys, Zinc 1997).

The principal uses of slab zinc are for electrogalvanizing and hot-dip galvanizing, mainly for sheet and strip. In Granite City, Madison County, one new hot-dip galvanizing plant with a capacity of 350 million tons began operating in 1996. Most of the secondary feed was crude zinc calcine recovered from dust generated by steelmaking using Electric Arc Furnaces (EAF). The dust was processed at the Horsehead Resource Development Company plants in Illinois, Pennsylvania, and Tennessee. At Alton, Madison County, Laclede Steel Company constructed a facility that could process 36 million tons of EAF-generated dust per year. This facility started operating in 1992. Eagle Zinc Company at Hilsboro, Montgomery County, produces zinc oxide, which is sold directly for use in animal feed and other agricultural purposes.

PRODUCTS MANUFACTURED FROM MINERALS

Cement

In 1996, four active cement plants in Illinois together produced 2.54 million tons of cement worth $168 million. The state manufactured about 3.23% of the total quantity of portland cement produced in the country. Illinois ranks eighth in portland cement production among the producing states. Production fell by 1% from 2.58 million tons in 1994 to 2.56 million tons in 1995. It again fell marginally by 0.7% to 2.54 million tons in 1996 (table 1).

The four companies producing portland cement in Illinois were Illinois Cement Company, a subsidiary of Centex Corporation, and Lone Star industries, both in La Salle County; Dixon-Marquette Cement, a subsidiary of Prairie Materials Sales in Lee County; and Missouri Portland Cement Company, a division of Cementia Oldings AG in Massac County.

Consumption In 1996, Illinois ranked sixth behind Texas, California, Florida, Ohio, and Georgia in the consumption of portland cement. The state consumed 3.3 million tons of portland cement and 0.66 million tons of masonry cement. Consumption of portland cement fell by 8% from 3.6 million tons in 1994 to 3.3 million tons in 1995. It increased to 3.48 million tons in 1996. The consumption of masonry cement increased by 2.6% from 76,000 tons in 1995 to 78,000 tons in 1996 (USGS, 1997, Mineral Industry Surveys, Cement 1997 Annual Review).

Clay Products

Clays mined in the state and imported from outside are used for manufacturing clay products. Production in the state followed a downward trend until 1989. Production then increased to about 0.8 million tons (fig. 18) in 1996. Information on the amount and value of clay products manufactured in Illinois is not available. Whiteware and pottery are the main clay products manufactured in Illinois.

Lime

The term *lime* refers to six chemicals manufactured by calcination of high-purity calcitic or dolomitic limestone, followed by hydration. Illinois ranked seventh in the nation in production of lime. Three plants in Cook County produced the state's entire output. Two plants owned by Marblehead Lime Co., a division of General Dynamics, produced quicklime and hydrated lime. The third plant, operated by Vulcan Materials Co., also manufactured quicklime.

The major end uses of lime are in chemical and industrial, environmental, construction, refractory dolomite, and other miscellaneous uses. The steel industry is the major consumer of lime, which is used as flux in steel refining to remove impurities. The steel industry accounted for about 28% of all lime consumed in the country. Lime is also used in the beneficiation of copper ores to neutralize

the acidic effects of pyrite and other iron sulfides in nonferrous metallurgical processing. In the environmental sector, lime is used in the softening and clarification of municipal potable water. Lime is also used in sewage treatment for sludge stabilization, as a coagulant aid in the paper industry, and to make precipitated calcium carbonates, a specialty filler used in premium-quality white paper. Other uses of lime are in the manufacture of alkalies in the chemical industry, as "milk of lime" in sugar refining, as dolomitic quicklime as a flux in the manufacture of glass, for soil stabilization in the construction industry, and as agricultural lime.

WATER RESOURCES IN ILLINOIS

The availability of water is crucial for economic development. Illinois has an abundant supply of surface and groundwater resources. The Mississippi River on the western border, the Ohio and Wabash Rivers on the south and east, and Lake Michigan on the northeast are the major freshwater bodies surrounding the state. The large tributaries to these major water systems include the Illinois, Kaskaskia, Rock, Sangamon, Big Muddy, Embarras, and Kankakee Rivers. There are 87,644 inland lakes, excluding Lake Michigan, with a total lake acreage of 309,340. Of the 87,644 inland lakes, 1,170 are publically owned lakes with a total lake acreage of 172,543. The Illinois-administered acreage of Lake Michigan is 976,640. Approximately 80% of the inland lakes are artificially constructed, including reservoirs ranging up to 24,580 acres in surface area. The artificial lakes are dammed streams and side channel impoundments, strip mines, borrow pits, and excavated lakes. The natural lakes include glacial lakes found in the northeastern counties, sinkhole ponds in the southwest, and oxbow and backwater lakes found along the major rivers. The lakes provide water for drinking and cooling purposes, help in flood control, recreation, fish and wildlife habitat, property value enhancement, and valuable ecological and aesthetic natural resources. Other surface water resources of Illinois include streams, lakes, and ponds. The state has approximately 900 interior streams. The total stream miles[2] is 32,190 miles, of which 30,246 miles are perennial streams.

In addition to the surface water resources, the state has an abundant supply of groundwater resources. Major aquifers underlying Illinois include the saturated sand and gravel deposits left in the last 1.6 million years by repeated advances and retreats of continental glaciers, the Pennsylvanian-Mississippian aquifers, the Silurian dolomite aquifer, and the Cambrian-Ordovician aquifers (U.S. Geological Survey, 1985)

Water Withdrawals

Water withdrawals and usage data are collected by the Illinois State Water Survey (ISWS) in cooperation with the U.S. Geological Survey (USGS). Total water withdrawals in Illinois in 1995 were 48,042 million gallons per day (mgd) (table 22). Groundwater provided 572 mgd (table 23) and surface water sources provided the rest. Water is used primarily for public water supply use, self-supplied industry water use, and by fish and wildlife. Public water supplies are defined as systems or wells that furnish water for drinking or general domestic use in incorporated municipalities and in unincorporated communities where 15 or more separate lots or properties or 25 persons are being served or are intended to be served for at least 60 days per year. Water is "self-supplied" when public supply is either unavailable or not used. When industries and commercial establishments use their own water source, such facilities are called "self-supplied industry sources." Water use systems are classified as "rural" when families and small communities are not served by public water supply systems. Among the different uses, the self-supplied water withdrawals constituted almost 96% of the total withdrawals, followed by the withdrawals for public water supplies (3%). Data on rural water use are not available since 1986, which may affect the general trends in total and ground water withdrawals presented in tables 22 and 23.

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[2] Total stream miles are based on the perennial stream miles in the River Reach File 3 (RF 3). The RF 3 is derived from computerized databases that reflect features on the 1:100,000 USGS hydrologic maps.

Table 22 Total water withdrawals in Illinois, 1978–1995 (millions of gallons per day)

Year	Public	Self-supplied	Rural	Fish & wildlife	Total
1978	1,771	44,331	220	44	46,366
1980	1,779	40,253	280	27	42,339
1982	1,740	31,216	266	27	33,248
1984	1,797	34,623	381	31	36,832
1986	1,806	35,536	306	37	37,684
1987	1,868	34,285	NA	73	36,227
1988	1,993	31,236	NA	68	33,296
1989	1,885	41,679	NA	93	43,656
1990	2,076	45,697	NA	69	47,841
1991	1,942	35,391	NA	87	37,420
1992	1,929	37,073	NA	72	39,074
1993	1,857	35,128	NA	65	37,050
1994	1,968	38,281	NA	57	40,305
1995	1,859	46,119	NA	64	48,042

Sources: Kirk, J.R., 1986, Water Withdrawals in Illinois, Illinois State Water Survey Circular 167; Illinois State Water Survey, Illinois Water Use Summary—1995; and K. Hlinka, 1997, Illinois State Water Survey, Department of Natural Resources (personal communication)

Table 23 Groundwater withdrawals in Illinois, 1978–1995 (millions of gallons per day)

Year	Public	Self-supplied	Rural	Fish & wildlife	Total
1978	458.2	259.1	220.0	8.4	945.7
1980	478.6	217.6	280.5	4.8	981.5
1982	465.8	248.6	265.9	5.0	985.3
1984	474.8	235.1	380.7	8.2	1,098.8
1986	437.1	204.2	305.9	11.7	958.8
1987	427.7	188.3	NA	14.0	630.0
1988	463.9	198.6	NA	13.7	676.2
1989	458.2	209.0	NA	36.1	703.3
1990	444.6	197.7	NA	44.1	686.4
1991	460.0	188.3	NA	39.0	687.3
1992	401.2	193.1	NA	14.7	608.9
1993	371.7	196.7	NA	9.5	577.9
1994	399.3	189.1	NA	6.9	595.3
1995	370.0	192.8	NA	8.9	571.6

Sources: Kirk, J.R., 1986, Water Withdrawals in Illinois, Illinois State Water Survey Circular 167; Illinois State Water Survey, Illinois Water Use Summary—1995; and K. Hlinka, 1997, Illinois State Water Survey, Department of Natural Resources (personal communication)

Water Uses

Public Water Supply

In 1995, the total water used for public water supply systems was 1,859 million gallons per day (mgd), of which 370 mgd was from groundwater sources and the rest was from surface water sources (tables 22 and 23). Public water supplies served about 90% of the state's population, and the remaining 10% of the population depended on their own supply of potable water.

Self-Supplied Industry

The total water withdrawals by self-supplied industries in 1995 was 46,119 mgd, of which 192 mgd was from groundwater and the remainder from surface water (tables 22 and 23). The major industries using self-supplied water are thermoelectric power generation, hydroelectric power generation, manufacturing, and mineral extraction.

Electric Power Plants

The electric power generation industry is one of the largest users of water (table 24). Although the thermoelectric power industry withdrew about 17,182 mgd of water in 1995, almost 99% of this water is returned to its source with a slight increase in temperature.

Mineral Extraction

The major mineral industries using water are quarrying, sand and gravel operations, oil extraction, and coal mining (table 25). In 1995, the total water withdrawn for mineral extraction (excluding oil extraction) was 37.6 mgd, of which 35.7 mgd was from surface water. Data on water use for oil extraction have not been available since 1986.

Water Quality in Illinois

Water in lakes, rivers, streams, and groundwater supports a variety of uses, ranging from drinking and other domestic uses to industrial processes and irrigation. Water in lakes and rivers supports

Table 24 Water use in Illinois for electric power generation, 1950–1995 (millions of gallons per day)

Year	Thermoelectric	Hydroelectric	Total
1950–1951	5,927	5,927	11,854
1960	9,051	21,155	30,206
1964–1965	9,120	NA	9,120
1970	8,745	NA	8,745
1978	19,919	22,593	42,512
1980	14,061	25,570	39,631
1981	10,088	25,975	36,063
1982	8,553	21,894	30,447
1983	10,980	22,381	33,360
1984	12,394	21,495	33,889
1986	12,213	22,671	34,884
1995	17,182	29,131	46,314

Sources: Kirk, J.R., 1986, Water Withdrawals in Illinois, Illinois State Water Survey Circular 167; Illinois State Water Survey, Illinois Water Use Summary—1995; and K. Hlinka, 1997, Illinois State Water Survey, Department of Natural Resources (personal communication)

Table 25 Water withdrawals by major mineral extraction industries, 1980–1995 (millions of gallons per day)

	Fluorspar			Quarrying			Sand & Gravel			Coal			Oil			
Year	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Grand total
1980	1.1	0.2	1.3	0.4	4	4.4	0.7	10.9	11.6	1.4	22.2	23.6	50.4	1.6	52	92.9
1982	1.6	0.1	1.7	0.1	1.8	1.9	0.7	11.3	12	1.5	25.8	27.3	40	1.4	41.4	84.3
1984	1.1	< 0.05	1.1	0.1	1.5	1.6	0.7	15.4	16.1	2.4	34.4	36.8	43.8	1.7	45.5	101.1
1986	1.1	< 0.05	1.1	1	1.4	2.4	0.7	16.3	17	26.8	0.2	27	3.9	28.8	32.7	80.2
1987	1.17	0	1.17	1.15	1.43	2.58	0.66	26.32	26.98	5.15	31.77	36.92	NA	NA	NA	67.65
1988	1.17	0	1.17	1.15	1.43	2.58	0.66	31.95	32.61	3.96	27.03	30.99	NA	NA	NA	67.35
1989	0	0	0	0.35	0.8	1.15	1.48	29.5	30.98	3.53	25.3	28.83	NA	NA	NA	60.96
1990	0.94	0	0.94	1.4	1.03	2.43	1.6	23.18	24.78	3.78	27.11	30.89	NA	NA	NA	59.04
1991	2.54	0	2.54	1.9	1.03	2.93	1.56	21	22.56	1.86	25.15	27.01	NA	NA	NA	55.04
1992	2.33	0	2.33	0.2	0.93	1.13	0.65	15.8	16.45	2.09	16.1	18.19	NA	NA	NA	38.1
1993	2.3	0	2.3	0.01	0.77	0.78	0.62	14.66	15.28	2.92	21.54	24.46	NA	NA	NA	42.82
1994	2.27	0	2.27	1.2	0.74	1.94	0.63	20.96	21.59	5.06	16.53	21.59	NA	NA	NA	47.39
1995	0	0	0	0.02	0.76	0.78	1.07	22.25	23.32	0.73	12.78	13.51	NA	NA	NA	37.61

Sources: Kirk, J.R., 1986, Water Withdrawals in Illinois, Illinois State Water Survey, Circular 167; Public-Industrial-Commercial Database, Illinois State Water Survey
Data on water use for oil and gas production are not available for the years since 1986.

fish populations for commercial and recreational fishing, as well as for boating, swimming, and other recreational activities. Most of these uses are, to varying degrees, dependent on the quality of the water, and hence water quality is important.

Both point sources and nonpoint sources emit pollutants into surface water, which affect its quality. Major point sources are factories and municipal sewage systems. Nonpoint sources include storm-water runoff, cropland erosion and drainage, and runoff from construction sites, pastures, feedlots, and woodlands.

Water quality problems in Illinois reflect problems at the national level. The Illinois Environmental Protection Agency (IEPA) monitors water quality in rivers, streams, inland lakes, Lake Michigan, and groundwater. River and stream water quality in Illinois has improved considerably since 1972, but most inland lake resources have shown a fluctuation or decline in water quality since IEPA began collecting data. More than 22% of the lakes assessed have shown a definite decline in water quality (Illinois Water Quality Report, 1994–1995), perhaps because lakes inherently function as traps or sinks for pollution from tributary watersheds or drainage basins. Lakes are most often contaminated by agricultural activities along with hydrologic system modifications thats contribute to nutrient loads, suspended solids, and organic enrichment.

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